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BRIEFLY TOLD.

THE NEW YORK AND EAST RIVER GAS COMPANY.—There can be no doubt about it that the tunnel under the East river, between Ravenswood, L. I., and New York City, through which subterranean avenue the proprietors of the New York and East River Gas Company eventually propose to convey gas for the partial supply of the metropolis, has reached what might be termed the open stage. That is, the headings have been joined, and one can journey now underground between New York and Long Island. As an engineering feat pure and simple it is a noteworthy accomplishment, for the work was carried on under great natural disadvantages, not the least of which was quite a stretch of "soft stuff" that had not been bargained for from the nature of the test borings which had originally been made. It is true that the promoters of the scheme at the outset promised its completion in less than six months, and their estimate of the cost thereof was considerably under $250,000, whereas in reality the time in which the work was done exceeded the predictions of the promoters by perhaps 14 months, and as for the cost—well, the people who put the money in it could tell that better than anyone else. However, the cost was vastly more than $250,000, and the end is not yet; not yet. The plain truth is that more months and many more thousands of dollars will have to go under the East river before the hole is ready to receive the pipes, of which we are told there are to be three, one of 48 inches in diameter, and two of 36 inches diameter, each. Why this division of the distributing system is to be made has not been satisfactorily explained, and in the absence of other knowledge regarding it we can only say that it looks to be an eminently wasteful plan. Indeed, there is no good reason why the tunnel itself should not have been designed to act as a single huge pipe. It will have to be lined anyway, and the lining could have been perfected so as to cause the channel to be gas-tight, at an expenditure considerably less than that which will have to be made under the proposed plans. This, of course, is put forth according to the view that the tunnel is to be a gas way, and a gas way only. However, what the gas men of this vicinity are most concerned with is to know when the suburban gas plant will be ready to compete with them in actual gas supply, and from all we can learn the time is quite distant; further, when the time comes, the East river folks will know that the existing Companies are quite up to the art of selling gas. One very amusing thing in connection with this affair is the unanimity with which three of the New York City newspapers hail Mr. Emerson McMillin as the apostle of cheap gas, the *Recorder* going so far as to declare that in his progress through the American gas field he has left behind him a broad trail of cheapened gas rates; but the *Recorder* man is strangely silent about the way that same trail has been paved with huge blocks of gas securities, some of which to-day are as heavy in the market as lead. Time was, we remember, when Mr. McMillin was hailed as the apostle of fuel gas, but he did not deliver the Westinghouse Company out of its uncertainties in that respect, and perhaps the proprietors of the New York and East River Company may eventually have to turn to some other Moses to lead them out of the wilderness. Furthermore, whatever credit belongs to him and his associates for tunneling the East river—which they have undoubtedly done—it nevertheless remains the fact that the scheme was originally proposed by that erratic genius, Mr. Wallace C. Andrews, of the New York Steam Company, when he was interested in the promoting of the Standard Gas Light Company of New York. In fact, he went so far as to have plans prepared and estimates made for a works to be located not far from where the East River Company's plant stands, the artery for conveying the gas to New York to be a tunnel under the East river. The site was purchased by Mr. Andrews, and we believe the plot so bought still stands in his name. After thorough consideration of the estimates, and the difficulties involved in the subsequent satisfactory distribution of the gas, the project was abandoned, and the papers relating to the project were put away in the Standard Company's boxes. We merely mention these things to show that there is much difference between originating and promoting. Meanwhile New York awaits the era of cheap gas that is to be the sequence of the latest efforts of Mr. McMillin and his associates.

LONDON DISCUSSES HIGH AND LOW CANDLE POWER GAS.—The steady going London gas man is much worked up at present over the discussion now rife in select English gas circles as to whether the present low candle value gas is to obtain in the future, or if the 16-candle article of to-day is to be replaced by one of say 12½ per cent. higher illuminating value, or if the 16-candle article is to be cut to 14 candles. The agitation of the subject has evoked some surprising opinions, not the least revolutionary of which was delivered by no less an authority than Mr. Thomas

Newbigging, who, in the course of a paper read by him before the Incorporated Gas Institute (the paper will be found in full in our issue for July 16th), gives voice to the remarkable statement "that gas of 14 or 15 standard candle power gives, cost for cost, as good an illuminating effect as gas of 18-candle power." Perhaps that is so of London gas, but it certainly is not so of American gas, no matter what city or town in this country is taken as the example. Possibly much of the meat in Mr. Newbigging's *ipse dixit* is to be valued by the knowing exactly what he means in the words "cost for cost." However, to show how the question is affecting the London gas world, we reprint the following editorial bearing on the question from the *Journal of Gas Lighting*, dated the 10th inst.:

The campaign for low grade gas has been hitherto restricted to the firing of salvos from certain big guns on one side, which have certainly succeeded in making no little noise in the technical world, and seemed to have hit their mark in the matter of the Plymouth skirmish. To abandon metaphor and return to plain language, the case which Mr. George Livesey, Mr. Thomas Newbigging, Professor Lewes, and Mr. Charles Hunt have committed themselves to uphold, has appeared from the outset to be plausible, and has likewise seemed to be strengthened by the now historical South Metropolitan experiment. Indeed, as recorded in these columns only last week, Professor Lewes regards the cause he has espoused as practically established by the results of that experiment. It was made manifest, however, at last Tuesday's meeting of the London County Council, that those who may have been disposed to take this view reckoned without Mr. W. J. Dibdin. On that occasion three reports by that gentleman were received and put into circulation—one on the price of gas, another on Mr. Livesey's experiment, the last on the existing testing arrangements; and in all three the redoubtable Chemist and Superintending Gas Examiner to the Council falls foul of the London Gas Companies and all their doings, especially the design to reduce the standard illuminating power of London gas. We are not particularly concerned just now to discuss Mr. Dibdin's first report, which is devoted to a statement, from the point of view of the chief local authority, of the position created by the disparity of the charges made for gas supplied to private consumers by the Gas Light and Coke and South Metropolitan Companies. His conclusion respecting this state of things is that it would appear to be impracticable to endeavor to bring about any alteration in the price of gas in the metropolis, with a view to a uniform charge, without a preliminary independent inquiry, which would doubtless be of the nature of that instituted by the Board of Trade in 1873, which resulted ultimately in the institution of the sliding scale. Mr. Dibdin admits that the question at present at issue is necessarily a complex one, and that an inquiry into it would be a lengthy procedure. Nevertheless, "in view of the great commercial importance of the question, and the advantage undoubtedly gained by the public on a former occasion by the establishment of a sliding scale," he thinks it would be well to move the Board of Trade in the direction specified. What a prospect for the experts!

The most salient feature of Mr. Dibdin's second report, on the South Metropolitan experiment, is the evidence it supplies of the results of this experiment which have led the author to take up a position directly opposed to that of Mr. Livesey and Professor Lewes, and to urge upon the County Council that not on any account should this body consent to a reduction in the quality of the gas. Mr. Dibdin arrives at this opinion by considering precisely the same facts as those recognized by Professor Lewes—namely, the failure of the ordinary methods of enriching to reach the consumer; showing that, as Professor Lewes puts it, the consumer has to pay heavily for enrichment which only affects the results obtained at the testing stations. Upon this showing, says Professor Lewes, enrichment should be dropped as a useless waste of money. Mr. Dibdin sees the matter differently, and urges that the failure of the consumer to benefit by enrichment as at present practiced merely proves that the enrichment is not properly done. The point is well taken, and it shows how the same question may be answered differently, according to their lights, by different people. Mr. Dibdin goes on to declare that the reduction in the quality of London gas from 16 to 14 candles would be tantamount to increasing the price of the 16-candle quality by 4d. per 1,000 cubic feet, having regard to the exigencies of the users of flat-flame burners. Instead of allowing the Companies to supply 16-candle gas to the testing stations only, says Mr. Dibdin in effect, let us rather insist upon their distributing 16-candle gas throughout all the district of supply, looking up shortcomings by means of the portable photometer, which he almost goes out of his way to prove in every respect reliable. One can forgive this little piece of self-justification, seeing how long the portable photometer and Mr. Dibdin have been "inseparables." The third report is an outcome of the second, and carries the war into the enemies' country with a vengeance. It is concerned to prove that there are not enough testing stations in London; and this is put forward as one reason why illuminating gas of low quality is found by the portable photometer in certain localities. It is especially the South Metropolitan Company that Mr. Dibdin accuses of getting off with too little testing, and he implores the County Council to stir up the Referees to take action in the matter forthwith.

Altogether, it must be conceded that these reports are a heavy attack upon the new movement in regard to the gas supply of the metropolis, and we may expect lively times if anything should come of them.

Gaseous Fuel.

[A paper read by Mr. T. Travers before the Incorporated Gas Institute.]

The question of gaseous fuel is receiving a good deal of attention—not more, nay, not even as much as its importance merits, whether regarded from a domestic or manufacturing point of view, for, by reason of its sanitary and economic advantages, it is destined to be the fuel of the future. Sanitary science has of late been largely directed towards the solution of the smoke abatement question; and every step in this direction must benefit our thickly populated towns. Take, for example, the metropolis, where the annual consumption of coal is about 9,000,000 tons, which, when consumed as solid fuel, discharge into the atmosphere hundreds of thousands of tons of impurities, injurious alike to animal and vegetable life, and from which arise those fogs which contain all the elements of matter, both liquids, gases and solids. A fuel which would deliver us from such ills would be a desideratum. Further, the increasing demand on our coal fields (the sheet anchor of this country's greatness) becomes a serious matter; for it must be remembered that, for the last 60 years—that is, since 1834—the consumption of coal has increased tenfold as compared with the advance made for the six centuries previous. Thus we are eating into our resources and living out of capital instead of revenue, the consumption being at the rate of 5 acres 2 feet thick every hour day and night. No reproduction is taking place, for coal is no longer forming; and, besides, the difficulties of winning it are increasing. The Royal Commission, which some time ago inquired into the matter (though some of their conclusions were not satisfactory) called attention to the fact that we must look to science to learn how best to care for these invaluable treasures.

The steps which we have been taking to introduce gaseous fuel for domestic purposes are a contribution to this important work which is not sufficiently appreciated. Take a ton of coal and use it in the good old way—that is, whenever you require a fire in your parlor or office, you have, so to say, to manufacture it there, in the same primitive fashion that it was done centuries ago, at the expense of damage more or less to your furniture, etc. But more important still is the waste of thermal power at the top of every chimney where the coal is thus consumed, even with the best appliances—a loss proved to represent 75 per cent. of the heat giving efficiency of the coal, and carrying with it other valuable constituents. Now let us treat the ton of coal according to our ideas—that is, carbonize it, with the result, you are aware, that we get gas for lighting and heating that will serve a moderate sized family for some months. Then we have the coke, which is capable of giving nearly as much heat as the original coal from which it was produced, and also other valuable residuals. As a further step in the way of economy, we can, by gasifying the coke, produce a fuel for the retorts which is particularly suitable to our industry, and which has also been found to be advantageous to other manufactures of an extensive character—effecting a saving in fuel ranging from 30 to 70 per cent., which must go a great way to husbanding our resources.

Although, generally speaking, gaseous fuel is now to be found in operation in every well constructed gas works, yet other manufacturers forestalled us in the introduction of it. When the subject was brought forward for the first time for discussion at our meeting, I remember the then President remarking that it was a novel question to bring before the Institute—indeed, it was not until it came to us with the hall mark "Made in Germany," that we thought of taking it up. It was on the occasion referred to that we were favored by the presence of one whose name will live in the annals of the century, for, by the application of his great genius to the arts and manufactures, it can be truly said he left the world better than he found it. I refer to the late Sir William Siemens. It has been admitted that to him is due the credit of having first applied gaseous fuel to our retorts.

It may now appear that the process is very simple by which coke is gasified to carbonic oxide, and the waste heat recuperated in order to raise the temperature of the air for combustion; yet it required much thought and patient experiment to render its application practicable. Doubtless the first installations, owing to their complication and expense, were not calculated to encourage the adoption of the system in any but works of the first magnitude—at least, this was the impression left on the minds of many of us who saw at Paris years ago the regenerator with which Sir William Siemen's name was first associated, the reversing surface regenerator. At the time, it was regarded as the most perfect method of obtaining high temperatures, and great economy at low temperatures. Expensive as was the plant at the Paris Gas Works, we were assured that the saving of fuel amply compensated the Company for the outlay, and that the patentee realized a handsome royalty. However, it was apparent that, before gas works generally

would avail themselves of the principle, the system should be simplified, and be automatic in its operation. Consequent on the attention given to the subject, we have now many adaptations of the principle (all bearing a strong family likeness), suited to every variety of circumstance, and designed to overcome obstacles previously considered insuperable.

In Cork there were many difficulties to contend with in adopting gaseous firing. Working under the old system, we had on an average realized from residuals over 70 per cent. of the coal. In this there is not much to complain of, but where better is possible, it is not the spirit of the age to be satisfied. In our case, the earlier forms of regenerators were out of the question, requiring as they did excavating to a depth of 8 feet or so. With us this was impossible, owing to the proximity of water, our city being built on islands, and our principal thoroughfares being formed by arching over rivers. This accounts for the fact that a Cork man, when at home, is always certain to be able to "keep his head above water." Another difficulty was that the site of the works had been literally scooped out of a rock, the boundaries being in some places 30 feet high, and the rock was of a very cross-grained character.

In order to overcome the above difficulties, we tried some years ago a system of gaseous firing, and although it did not prove to be as successful as we had expected, I deem it not inappropriate to describe it, for partial failures often lead to important suggestions, particularly in an Institute like this, comprising men of such extensive practical experience. The experiment which was made was with what is generally known as producer gas, and for this purpose we erected one of Wilson's gas producers in duplicate. This is a sort of cupola furnace, contained in a cylindrical iron case. It varies in diameter according to its capacity for work, and is usually constructed about 10 feet high. The bottom forms a solid hearth, without any grate bars, on which the fuel rests in a mass 6 to 8 feet in depth. There is a box situated on the hearth, having openings in its sides, through which are forced air and steam for decomposing the fuel. The clinker and incombustible residue are removed through doors at the bottom. The upper portion is furnished with openings, through which the gases are led off, and at the top is an arrangement for charging, consisting of a bell and hopper, with slide to prevent the escape of gas whilst doing so. The interior being nearly full of coke, breeze, or small coke, air and steam are injected into the center of the fuel from each side of the central tuyere pipe, which communicates with the steam jet blowers outside. Rapid combustion takes place, resulting in the formation of carbonic oxide and hydrogen, which, passing upwards, escape into the annular flues surrounding the upper portion of the chamber, from which they pass through the down pipe to the furnaces of the retorts to be heated. The whole of the fuel except the ash was transformed into gas, of which an analysis gave the percentage in volume as 39.9 per cent. of combustible gas.

In connection with the gas producer, there was also erected a regenerating arrangement, consisting of two chambers on the top of the benches and close to the chimney. Within these chambers were a series of cast iron pipes. The waste heat from the main flues was made to pass around the pipes, and the air for combustion was forced through them by a blower or fan, in order to transfer the heat rapidly. Iron pipes exposed to waste gases, so as to heat the air passed through them, will stand for years if the air be so supplied as to ensure a constant current and consequent uniform withdrawal of heat from the pipes. The heated air was conveyed to the furnaces, and there, with an arrangement on the blow pipe principle, it met the producer gas for combustion. We were encouraged to look for success in the trial by the results obtained by this system in smelting steel, etc., and also because it would be a means of converting breeze, which is a drug to many, into a valuable fuel.

Five settings of retorts, with eight in each oven, were heated in this way, and in order to make the test complete, we had back to back with these a similar number of retorts fired in the ordinary way. We got the gas fired retorts to an average heat capable of carbonizing each about 9 cwt. of coals in the 24 hours, and we sent all the coke produced from the coal into the yard for sale. We found, however, that the cost by which those results were obtained did not compare favorably with the old system. Were we to go over the same ground again with the experience we have had, the following alterations would, I think, tend to bring the system within measurable distance of our requirements.

(1) The labor was a large item; a good deal of it being caused by having to stop and clean out the producers every 24 hours. Since we made the trial, an automatic discharger has been invented by Mr. Wilson, by which the solid matter is made to sink through water, and is then forced out by worms up an inclined plane. In this way, clinkers of many inches cube can be sent out, and when too large they are crushed—the water preventing any gas from escaping. If the power which is used for discharging the producers could be also applied to charging them, the point would have been met.

(2) In erecting the producers, they were placed in a house apart from the retort house which they were intended to heat, the result being that a good deal of condensation took place between the "down come" and the point of combustion. By having the producer as close to the retorts as possible, the gas would be delivered at a much higher temperature, and consequently with increased efficiency.

(3) Instead of applying the system to retorts set on the usual plan for solid fuel, suitable combustion chambers for the more uniform distribution of the gas would, I think, economize it.

The matter, I submit, has a special interest for gas companies, offering, as it does, the prospect of utilizing the least salable of our residuals.

An opportunity was recently afforded of making another trial of gaseous firing. Having to reconstruct some old retort ovens, it was thought that it would be well to see if any of the existing plans would meet our case. Many were inquired about, but our old enemy water was apparently making the position impregnable. Fortunately we heard that in two or three works in the north of Ireland there was in operation a suitable system. The advantages claimed for it were that it could be made to effect a considerable saving under adverse circumstances—such as natural difficulties, shallow drainage, height of roof, etc.—and that it could be adapted to either large or small works, even to settings of two retorts. The use of all unnecessary ramifications of flues is avoided; and especially is this worthy of consideration where they are obtained at the expense of excavation. The system I refer to is that known as Hislop's, the patentee of which is the well-known engineer of the Paisley Gas Works, Mr. G. R. Hislop.

As the difficulties, both natural and artificial, which Mr. Hislop proposed to overcome existed at the Cork Gas Works, the Directors decided to afford him the opportunity of doing so. We had water sometimes as high as our ash pits. The rock on which the bed of the old ovens rested was nearly as hard to chisel as chilled iron—being largely composed as it was of silica; and the roof, a legacy since the time when gas was first made in Cork in the year 1822, was very low. The necessary drawings were obtained from Mr. Hislop; and the copies of them here so fully illustrate the system, that a very brief description is all that is necessary.

The producer is included in the settings, and does not extend beyond the mouthpiece line; thus leaving a clear way for coke barrows, etc. The special feature of the producer is that it offers increased facilities for the removal of clinker, etc. It is oblong in shape, and the floor is formed of slopes or half arches springing from a central block. The spaces under the slopes are provided with ash pans for receiving clinker, etc. These are supplied with water, which is evaporated by heat from the waste gases, so arranged as to be made to pass under the protecting tile on which the pans rest. The regenerators are on either side of the producers. They are constructed of special fire tiles, which are so arranged that the waste gases from the ovens pass down the opposite direction of the secondary air, and thus the two are made to traverse several times the length of the retorts. From the side of the regenerator, and over the pans, is thrown a curved plate, having ports for the admission of air and steam to the producer. The air to the producer is regulated by air-tight doors, having movable discs inserted in the cast iron frame which forms the front of the producer. In this frame are also two air-tight doors, one above the floor of the retort house, and the other below in the sunk chamber. The upper door is for charging the producer, and the lower door is for clearing it out.

For feeding the producer with hot coke direct from the retorts, there is a very complete arrangement consisting of a movable funnel, so arranged that the coke from the two center retorts falls by gravitation into the producer. Not only is this much easier for the men (being automatic in its operation), but it adds much to the efficiency of the fuel, as the time of charging the producer is much shorter, and the coke is not cooled in any way, as was previously the case when the man had to draw the coke into a barrow, and then with a shovel charge the furnace. When the funnel is not required, it falls back out of the way, and an air-tight door closes the opening by which the coke has been delivered.

The secondary air supply is regulated in the same way as the primary air—by a sliding disc; and the waste gases are regulated by a horizontal damper just before their exit to the main flue. The combustion chambers are right over the producer, with ports so arranged that the

combustion is perfect along the whole of the setting. The sunk chambers are about 4 feet deep, and extend to about 8 feet in front of the bench. They are covered with suitable doors, which form a good charging floor for the stokers. When all is complete it forms a very compact job.

The arrangement with Mr. Hislop was for the erection of eight benches of eight retorts in each. The company did all the excavation, formed the main flue under the ovens, built the oven arches, and provided and erected hydraulic mains, ascension pipes and mouthpieces. Mr. Hislop's portion of the work was to build the producers, set the retorts, and provide all special castings—such as the producer fronts, doors, floor plates, etc. The cost of the entire labor and materials was a little over £1,900—say, £30 per mouthpiece. It would have been fully £2 per mouthpiece less, had it not been for the cost of cutting away the rock and laying pipes, sinking a well and erecting a steam pump to draw off the water. We have to continue to use this steam pump, but the water is useful for the works.

In consequence of the roof being low, we had to lower the hydraulic main and to make other alterations; and even after doing so, the arch pipes are as high as the tie rods of the roof, giving the men very little headway to clean them when necessary. In order to gain depth, we had to do away with having the water pans heated by the waste gases, using steam from the boilers instead. However, when the work was heated up, there was no undue shrinkage or settlement of any kind; and the retorts showed a perfectly uniform heat from front to back. When we commenced charging, we found the heats were inconveniently high, as a result of which we were much troubled with choked pipes, and the tar in the hydraulic main became all but pitch. We tried steam injecting into the main, and this gave temporary relief; but what we found to be still more effectual was mixing tar taken from the condenser tank of another retort house with the thick tar. This had the effect of dissolving the latter, although it was almost solid. We also made an arrangement for drawing the tar off from the bottom of the main, with a suitable contrivance for regulating the seal.

We at first altered our system from scoop charging to shovel charging, as is the practice in Scotland; but we found that it was not easy to get the men to send home to the bottom of the retorts the small Durham coal which we use. As a result, the coal was too much to the front; and the slackness of it at the back increased the tendency to stopped pipes. We therefore reverted to scoop charging, with more satisfactory working.

As to the improved returns, in view of the fact that we have only been a few weeks at work with the system, it is too soon to give statistics on all the points; but I am able to give one or two, which will show that they are of a satisfactory character. I will premise by remarking that, while a high yield per ton and per mouthpiece is very desirable, yet under certain circumstances a moderate yield will be found to produce gas of a good illuminating power at a less cost. I am aware that over 9,000 cubic feet per mouthpiece, and between 10,000 and 11,000 cubic feet per ton, may be obtained. I have no doubt but we could do the same; yet, for reasons which I will give, it would not with us lead to incressed economy.

The coal which we can obtain on the most favorable terms is unscreened Newcastle, and from this we get, without cannel, about 9,500 feet of 16-candle gas. Now, when I take in our case the cost of coal, less residuals, and compare it with the cost of the coal, less residuals, in the works where the higher yield per ton and mouthpiece is obtained, I find that it gives 2½d. per 1,000 cubic feet in favor of the former. One thing is certain, and that is that we are now making more gas with half the number of retorts that we had in operation at the corresponding time last year; and with a favorable market for coke, it is of importance to us to obtain the best results in this respect.

I will show you how far we have improved in this matter of £ s. d.; for directors, as the guardians of the capital of the shareholders, naturally regard the financial question as of the first importance. Our clearly ascertained weekly coke sales show a gain of £25; and with the outlay of £1,900 yielding a saving of £25 per week, it is easy to see that a little over 18 months will clear off the entire expenditure. There is also a saving in wear and tear and labor, the extent of which I cannot give at present.

In conclusion, although we were at first slow as a body in taking up this question of gaseous fuel, we can now look back with satisfaction at the progress that has been made within the last decade. No longer are the advantages of it confined to large or medium sized works, but the smallest can share in them, as I have seen in practical operation. We have therefore here a case where the greatest good is done to the greatest number; and this is what we need at the present time, when we are engaged in such active competition. Even with the measure of success which we have attained, higher results are still possible; and we are reminded of this by our friend Mr. Edison, who has said recently that he considers it possible to get as much energy from 250 tons of coal as is now produced from 3,000 tons—in fact, the matter is engaging his attention. When he has solved the problem, the Duke of Argyll may with perfect confidence extend the time of the adjournment of the Royal Commission on our coal resources by two or three centuries.

Gaseous Fuel in the Retort House.

[Prepared by Mr. T. S. Cleminshaw for the Incorporated Institute.]

There must be few indeed amongst those connected with gas engineering who will attempt to deny that the retort house claims their chief attention; for neglect of this important part of the engineer's charge cannot be made good in the subsequent operations. Relying, therefore, upon this axiom, and at the same time desiring to add to the large stock of literature on this by no means exhausted topic, must be the excuse for offering the results of years of research. It is not claimed that perfection has been reached in what is now brought forward; but it is hoped that, in recounting these experiences, others may be stimulated to improvements, and may profit by good results, as well as learn to avoid mistakes. If such is the outcome, the object of this paper will be achieved.

When entering upon my duties as Engineer of this Company, there was a retort house at work containing a stack of eleven beds of three cast iron retorts, 22 inches by 14 inches inside measurement, and 8 feet 6 inches long; and it soon became evident, in the face of a heavy growth of consumption of gas, that efforts must be at once made to improve matters. The winter having passed, part of the stack was pulled down bare to the foundations; new centers were made, and a fresh stack built to accommodate ten beds of sixes, 22 inches by 14 inches inside measurement, and 9 feet long, with clay instead of iron retorts. Eleven years ago regenerative firing was scarcely well enough developed to encourage the adoption of that system, nor did the length of time permit of such extensive alterations. The nature of the ground, from information received, was declared to be such as would preclude any chance of success in sinking 10 or 12 feet, as the retort house was within 100 yards of a tidal river, and the ground was black mud, very unsafe and treacherous. Subsequent excavations about the works brought about the determination to sink through this, and it was found that, though soft and very treacherous (unless well timbered), a good clay foundation was obtained. But, as if the risk of excavation was not enough, a wall, 23 feet high and 1 foot 10½ inches thick, on a rubble foundation, had to be negotiated, and this wall formed the support of the retort house and coal store roof. The foundation of the wall reached 6 feet below the floor; and at a distance of 6 feet away from this wall, inside the retort house, a heavy retaining wall was put in, 12 feet deep and 4 feet 6 inches thick at base, tapering to 2 feet 3 inches at top, and faced with 9-inch brick in cement, and backed with cement concrete 9 to 1, composed of old bricks, retorts, clinkers and sand. The foundation of this wall communicates with a permanent pump, and a small pump keeps the foundation drained—there being pipes laid in the foundation of the wall to lead the water away. Cross walls 14 inches thick (provided with arches for facility of communication), of brick and cement, were placed from this retaining wall to correspond with the division walls of the benches, which were underpinned. The floor of the retort house was laid on the cross walls, and consisted of corrugated steel plates, leveled up with concrete, to receive the brick-on-edge floor. The floor of the vault was concreted, and a gutter to carry off any water was led to a pit, which is cleaned out, as required, by a steam ejector.

Outside generators were placed *in situ*, 9 inches away from the front of the bench, and the gas duct to the setting was laid upon iron supports across the distance between the setting and the generator. A 5-inch thick tile was laid on the irons, covered again by a course of firebricks; 9-inch walls were added, and the cover was another 5-inch tile. [This tile later on fell in, and was satisfactorily replaced by arch bricks.] The gas duct was 14 inches by 14 inches inside, and traversed the setting 7 feet, being provided with four silica nostril blocks, in halves, each nostril being 9 inches by 2½ inches at the floor level. The secondary air combined with the primary air at a level of 5 inches below the floor, after having been heated in a portion of the brickwork on either side of the gas duct; and four flues, 10 inches by 6½ inches were formed, through which the air traveled about 25 feet. This system, though affording much improvement on the old style of furnace,

is not deemed complete; but it gave such good yields, and effected such economy, that now two more benches are being constructed, one of which will allow of the waste gases heating both the primary and the secondary air.

It has been considered, in the interests of economy, most desirable to alter the old house, instead of building a new one at an outlay of well-nigh £15,000; and the use of gaseous fuel has fully justified the alterations, which have not yet cost one-tenth of the expense of a new house. Some idea may be formed of the saving effected, when it is recorded that 8,500 cubic feet formed the extent of one man's labor at iron retorts per shift; 16,000 feet with clays; 22,000 feet, and even more, with gaseous firing.

The oven is 7 feet 1 inch wide, 9 feet 3 inches long, and 7 feet 9 inches high, to inside the semicircular arch. The sides of the oven receive a 4½-inch wall, 4 courses high, 2½-inch bricks; a midfeather wall, under the center of the retorts, from the back of the setting to within 9 inches of the front wall; and a 14-inch furnace wall (9 inches of the front part detachable for repairs), from the inside of the front wall to within 13 inches of the usual 4½-inch back wall. The two 14-inch furnace walls are joined across the back end, and form the "back chamber." On these walls the bottom retorts are set, with the flanges close to the side of the oven; and the bodies are packed with broken bricks and fireclay, so as to make them solid. Three 9-inch furnace arches, of best silicon bricks, are turned off the bottom retorts, and leveled up across to form the bed for the middle retorts; the 4½-inch brick wall and 9-inch wall of the back chamber being similarly treated.

The middle retorts are now run in, bedded, blocked at bottom with feather edges, and set 3 inches away from the side of the oven to the body of the retort; and stays are placed from the oven to the sides. Four 4½-inch arches, 9 inches wide, are then thrown off the middle retorts, to receive the top retorts, and the back chamber wall carried up; and after all being leveled across, so as to leave a space of 3 or 4 inches between middles and tops, the two retorts are run in, and placed so as to leave 3 or 4 inches between the bodies of the same. These in turn are blocked at the bottom with feather-edges, as well as in the center, and suitably stayed on top to the arch of the oven. The retorts, and all internal brickwork, receive several coats of Purimachos cement, which seems to prevent the adhesion of dust, and protects the oven, as well as the brickwork, from the fire.

The furnace gases enter the setting at the floor, in the center, rise and flow over the bottom retorts towards the back, along the walls of the oven, down at the ends of the retorts, over the bottom retorts into the back gas chamber, over the middles, and over the tops to the back chamber; then split and traverse under the bottom retorts, between the 14-inch furnace wall and the midfeather wall to the front of the bench; turn outwards to the flue between the midfeather wall and the side of the oven; then to the back of the oven, up an upright flue on each side of the setting to the main flue, where there are two dampers—a convenient way of insuring an even heat when a cold bench is next to the one in action.

This forms the standard setting here; and it is very uniform in heating—both from end to end of the retorts, as well as all round the setting itself. It renders blocked ascension pipes a rarity—with Newcastle (N. S. W.) coal; scarcely ever more than a few inches beyond the mouthpiece being choked, even when gaseous firing is used, and a yield of 8,000 cubic feet of gas per mouthpiece obtained. White's anti-dip valves are used, the gas supply being through 2-inch pipes, attached to bridge pipes over the dips, and a separate 12-inch main to collect the gas. The tar and ammoniacal liquor run into the hydraulic main as before, and through a tar main to the well. These 2-inch mains, though answering with ordinary firing in the furnaces, prove to be incapable of taking away the gas now, and they will shortly be replaced by larger ones.

In starting the system of gaseous firing, the greatest difficulty met with proved to be the admission of secondary air, and the pages of the *Journal of Gas Lighting* were diligently searched for well defined rules to guide the fixing of the proportions of air, but with small success. Some were positive that the primary air should be in excess, and others maintained the contrary; so the conclusion arrived at was that, as each wanted various proportions (influenced doubtless by the style of setting, length of the flues, height of the chimney, as well as by the distance from the chimney), the safest plan was—*to find out*. Careful measurements were made of the primary and secondary airs, the coals were weighed, the coke was measured, and the make of gas per mouthpiece was noted. This was done during 72 hours, and then the slides were altered and the setting allowed to run for 96 hours before another testing was entered upon.

The figures given in the appended tables speak for themselves. No. 1 bed was the standard setting employed here. No. 2 bed was so arranged that the primary air entered the setting in the same positions as in No. 1; but the secondary air entered through port holes under the bottom retorts, and the course of the furnace gases was also distinct from the standard setting. The gases leaving the port holes went in four sheets among the retorts, and round outside the bottom retorts, which were set 3 inches away from the sides of the oven; then over a partition 5 feet 3 inches high to the back chamber; then they were split under the ends of the bottom retorts, and went straight up the main flue.

Results of Subsequent Trials.

No. 1 Bed, with 9-inch by 4-inch Nostrils.—Owing to inferior bricks being employed in the sides of the gas duct, the nostril blocks were left without support, and fell in, and both they and the bricks got badly mixed up. The tile which covered the neck of the gas duct from the generator followed suit at the end of the winter; and, of course, necessitated repairs. Advantage was taken of this to employ arch bricks (Cliff's Aluminous) over the duct leaving the generator, as well as to form 14-inch rings, 9 inches thick, over the duct inside the setting, which allowed the use of four nostrils, each 11 inches by 6 inches, for the two gases to enter the combustion chamber, in place of the 9-inch by 4-inch ones as before. The sides of the duct were lined with Glenboig bricks, a "straight joint" having been left, to facilitate such repairs. These nostrils answer admirably, the retorts being untouched, save for the usual patching given when let down. The yield of gas has reached 8,000 cubic feet per mouthpiece, the primary air passage being 16 inches in area, and the secondary air passage 8 inches in area.

No. 2 Bed, with 9-inch by 4-inch Nostrils.—The bricks in the sides of the duct ran even worse than in No. 1 bed, and towards the close of the winter a large hole was the result, behind the front wall of the setting. The bricks became run together in the duct with the pieces of nostril blocks. The course of the furnace gases increased the heat of the bottom retorts beyond that of the tops or middles, and the ascension pipes of the bottom retorts, from the increased mouthpiece heat, began to block up. As the retorts in this bench were worked out they were removed, as well as the outside generator; and the generator is now placed inside the setting, and consists of a straight opening, parallel throughout, 18 inches wide, 3 ft. 9 in. long, and about 5 ft. 6 in. deep. The secondary air enters at the sides of the generator at the oven floor line (three 4½-inch by 2½-inch openings each side); and the course of the furnace gases and the style of setting is altered to the standard. The yield of gas per mouthpiece is 8,000 feet, and the economy of fuel is 15 per cent. over the outside generator—dry steam being used at the hearth, which has no fire bars, in place of steam and water. A further economy of £60 in erection is obtained over the outside generator. This furnace furnishes the next step of improvement, and is being supplemented by the full depth recuperative furnace previously mentioned.

It will be worth noticing that, in the matter of nostrils, the first start was with 9-inch by 2½-inch ones, then 9-inch by 4-inch, 11-inch by 6-inch, and finally one large nostril, 3 ft. 9 in. by 1 ft. 6 in. The latter style claims attention on account of its being the simplest in construction, permitting an easy flow of the gases among the retorts, and it is not complicated in working, nor does it require any fancy designs of blocks or quarries. In fact, the design of the new recuperative furnace calls for the utilization of about twelve plain tiles 24 inches by 15 inches by 2½ inches, and about sixty tiles 18 inches by 11 inches by 2½ inches. These tiles are plain, not rebated; and when, in cutting out No. 2 furnace, the tiles were taken out to suit the alteration of setting, they were found to have been air-tight, which fact is attributed to the employment of careful labor, as well as to the admixture of Purimachos with fireclay.

It will, therefore, be observed that a somewhat fresh departure is taken from the beaten track of generator setting, inasmuch as no "specials" (beyond the enumerated tiles) are employed, and the rest of the work is completed with such bricks as squares, splits, feather-edge, arch and bevels. It has been found that a large surface for fireclay material is a source of danger from cracking, and therefore preference is given to ordinary materials. There is, moreover, less risk of damage from transit, as well as a cheaper article, both in first cost and in packing—a by no means inconsiderable item in these parts.

The following tables will, it is hoped, speak for themselves, as showing the effect of various admixtures of primary and secondary airs, and they may be somewhat at variance with accepted ideas. Tables A and B represent actual results during 72-hour tests, and they show conclusively that an excess of secondary air cools down the setting. In the instances given, the effect was noticeable; but it was thought desirable

that the test should continue, and the figures be tabulated for future reference, even though some loss might arise in the shape of fuel and production of gas. Table C gives information culled from various sources, and will explain the difficulty in arriving at any well-defined rule as to the proportions of primary and secondary air. The authorities, where practicable, are added; but a few examples are not so treated, as the information was not given with any idea of public property being made of it. Examples No. 3 and 4 are from the same works, and Nos. 5 and 6 are from different works, and are examples of regenerative firing as practised in the Colonies adjacent. In Nos. 7 to 10 inclusive no waste gases are utilized, and the secondary air is heated by contact with hot brickwork on either side of the gas duct and below the floor of the setting.

TABLES A AND B, *Showing Result of Varying Proportions of Air.*

	Test No. 1.	Test No. 2.	Test No. 3.	Test No. 4.
A.—No. 1 Bed—				
Primary air, area in inches....	9	12	18	18
Secondary air, area in inches..	4½	6	12	9
Coal carbonized, tons.....	9.75	10.05	11.55	10.65
Duration of charge, hours.....	4	4	4	4
Coke sold, bags.....	123	121	142	146
Breeze sold, bags.....	5	4	5	5½
Make per mouthpiece, cu. ft...	5,600	6,020	6,420	5,917
B.—No. 2 Bed—				
Primary air, area in inches....	7½	9	18	18
Secondary air, area in inches..	25½	18	12	9
Coal carbonized, tons.....	9.15	8.55	13.05	13.05
Duration of charge, hours.....	4	4	4	4
Coke sold, bags.....	100	87	146	154
Breeze sold, bags.....	4	2	6	7
Make per mouthpiece, cu. ft...	5,250	4,890	7,500	7,500

TABLE C, *Showing the Various Proportions of Primary and Secondary Air Claimed by Authorities.*

No. of Ex'mple	Air Supply.	Area in Inches.	Authority.	Remarks.
1	Primary...	25	*J.G.L.*, 20-12-87 p. 1,095.	Full.
	Secondary..	12½	.....	Regenerative.
2	Primary...	12,000 ft. per hour.	*J.G.L.*, 21-2-93 p. 314.	do
	Secondary..	28,000 ft. per hour.	....	do
3	Primary...	18	.....	do
	Secondary..	10	.....	
4	Primary...	9	.....	do
	Secondary..	10	.....	
5	Primary...	4½	.....	do
	Secondary..	18	.....	
6	Primary...	27	.....	do
	Secondary..	4½	.....	
7	Primary...	22	T. S. Cleminshaw.	½ depth furnace
	Secondary..	8	Furnace 3′ 0″ x 18″	5′ deep.
8	Primary...	15	do do	8,000′ per mouth
	Secondary..	5	Furnace 3′ 9″ x 18″	
9	Primary...	16	do do	11″ x 6″ nostrils
	Secondary..	8	Outside generator.	8,000′ per mouth
10	Primary...	18	do do	9″ x 4″ nostrils 6,416′ per mouth Same setting as No. 9.
	Secondary..	12	do do	

In conclusion, it is thought that the following deductions may be drawn from the preceding notes:

(1) That the amount of primary and secondary air should only be fixed after careful and searching trial.

(2) The amount will vary in each case according to the style of setting, length of the flues, and draught of the chimney. (In the present case, the chimney was on the end of the bench, 2 feet 3 inches by 2 feet 3 inches top and bottom, and 61 feet 6 inches high.)

(3) Only the best materials, supplemented by careful labor, should be employed, finally finished off with a wash of Purimachos.

(4) The employment of small nostrils from the gas duct seems to be a mistake, as shown in example No. 10; the alteration, as in example No. 9, increasing the result per mouthpiece, without the setting receiving any alteration.

(5) The style of setting obviates, to a greater degree, that *bete noire* of gas engineers, stopped ascension pipes; and this is attributed to the fact that the course of the furnace gases is taken towards the backs of the retorts, giving uniform heats, and keeping the mouths of the retorts cooler than when the gases are brought to the front of the setting, under the bottom retorts, up a back chamber, and then through an opening in the crown of the arch to the main flue.

(6) Last, but by no means least, there is a distinct saving by the proper use of gaseous fuel, of room, wear and tear, fuel, labor and coals.

An English Contemporary on the Carnegie Company.

The *Iron and Coal Trades Review*, of London, recently had the following to say respecting what it was pleased to term "The Colossus of the Iron Making World:"

The question has often been asked of late years, Shall British iron and steel manufacturers ever have to face the competition of the United States in foreign markets? A few years ago it seemed to be impossible that such an event could ever come to pass, but it has been brought much nearer of late years than it ever was before, and that mainly through the instrumentality of one firm, who are now ahead of all kindred firms whether on the European or on the American continents. This firm are known as the Carnegie Company, and their various works are mostly centered in and around Pittsburgh. The Carnegie Company are hardly likely to enter European markets without making a notable impression on them, and for that reason it may be of interest to say something of their resources and methods.

Andrew Carnegie entered the iron business as far back as the year 1860, when he and his partner, Harry Phipps, purchased the Keystone Bridge Works, near Pittsburgh, for the sum of $1,250, which they had to borrow. Mr. Carnegie was then about 26 years old, and his partner was little more than of age. The concern prospered, and they were able to go on extending their plant and production. During the next few years, while the civil war was in progress, they realized very large prices. The result was that they were able to extend their operations to the manufacture of rails, plates and other descriptions of finished iron and steel. About 1870 they acquired the Edgar Thomson Works, on the Monongahela river, near Pittsburgh. Here they constructed one of the first Bessemer steel works erected on the American continent. One of their earliest acquisitions was the Beaver Falls Works, where they undertook the manufacture of wire rods and merchant steel, and at other subsequent periods they have either built or acquired the Homestead Works, the Duquesne Steel Works, the Lucy furnaces, and the Upper and the Lower Union Mills, at Pittsburgh. They are now able, at these several establishments, to produce nearly 1,500,000 tons of pig iron and more than 1,500,000 tons of merchant iron and steel per annum. They are also the largest owners of coal royalties in the Connellsville coking region near Pittsburgh, where they produce something like 2,000,000 tons of coke per annum. They employ over 25,000 hands in all their different undertakings, and they pay upward of £60,000 a week, or £240,000 a month, in wages.

Compared with the Carnegie Company, neither the Krupp Works at Essen, nor the Schneider Works at Creusot—the largest establishments of their kind in Germany and France respectively—are of much account. The Carnegie Company produce almost as much pig iron as the whole of France, and more than twice the quantity of steel. They produced almost as much steel as the whole of Germany, and five or six times the production of Belgium; while they are looking forward to producing next year as much steel—Bessemer and open hearth together—as the whole Bessemer output of the United Kingdom. The capital expenditure of this colossal concern amounts to more than six millions sterling, and Mr. Carnegie has been offered and has refused a sum of about ten millions sterling to buy up the whole enterprise.

The methods and policy whereby this gigantic business has been built are the outcome of the fertile brain and rare organizing and administrative power of the man. Andrew Carnegie has been the head, soul and mind of the Company who bear his name for more than a quarter of a century. But he has, nevertheless, refrained from the drudgery that would almost naturally be expected from any one who accepted the responsibility of carrying on such establishments as Edgar Thomson and Homestead, and has passed a large part of his time each year in Europe. Krupp and Schneider inherited businesses that were built up for them mainly by the efforts of their fathers. The Dowlais Iron Works, the largest in Wales, were inherited by the present Lord Wimborne from wealthy ancestors, and the same remark applies to the great Gartsherrie Works of Baird & Co. in Scotland, while the Barrow Hematite Steel

Works, the largest of their kind in England, were called into existence, not like Canning's new world, to redress the balance of the old, but to minister to the wealth of a ducal family that was already understood to be rich beyond the dreams of avarice. The case of Carnegie and his partner was different to all these. For some years after they had started business on their borrowed capital of $1,250 they had a hard struggle, and one of them is accustomed to descant with something approaching enthusiasm on the many interviews that they had with the local bankers in order to "raise the wind." The most gigantic business of this kind in either ancient or modern times has, in point of fact, been established within 30 years or so by these young men who could not raise £300 between them. This business has prospered exceedingly where other businesses carried on alongside and apparently in the enjoyment of equal advantages and resources have gone to the wall. It controls to-day both prices and production on the American continent, and is a permanent menace to the older iron industry of Europe.

How has all this been accomplished? Mainly by the adoption of and rigid adherence to three principles or methods, namely:

1. Giving a partnership interest in the business to such promising and capable young men as entered the service of the Company.

2. Securing orders at any price rather than let them go elsewhere, and having an organization of competent agents all over the United States for the purpose of looking after orders.

3. Taking care to obtain the largest possible output from a given plant, and a given capital expenditure and a given outlay on labor, etc.

It is likely to appear all but incredible that the principal partner in this concern, even in its most struggling days, and when the greatest efforts were being put forth, was seldom on the spot, but left the work of administration and control to others. Mr. Carnegie's system has all along been to select men, mostly uncommonly young, for places of trust, but he did not give them half confidences or half responsibility. "Trust them all in all, or not at all," has been his motto. To whet their interest and their application, however, he has given them a certatn proprietary interest from time to time, until there are now 28 partners in the firm besides himself. The partnership, however is not a permanent one, nor without limitations. On the contrary, the majority of the partners can always decide that any individual partner shall retire if his work is not satisfactory, and thereupon he is paid over the amount at which his interest stands in the books, or, in other words, at its par value. Several partners have had to retire in this way. Mr. Carnegie himself always retains about 60 per cent. interest in the whole concern, so that if its capital value be taken at £10,000,000—its value in the books is not nearly so much as this—the principal's interest, which, of course, gives him always a controlling voice, will not be less than £6,000,000. It is the interest of every one of these 28 partners to do his utmost for the prosperity of the concern. His whole fortune is embarked in it. The Manager or Superintendent in the Carnegie Company is not allowed to become interested in other concerns. His whole heart and soul is understood to be in the one business, and in that only. His only aim, his only interest and his only ambition is to make the Carnegie concern the first and the only one of its kind. The impulse of ***amour propre*** is the one that has chiefly stimulated the partners to the efforts they have undertaken and are making from day to day. "We must be, and we must remain, at the top," is the rule of action throughout the whole vast organization, and this applies equally to the manufacture of pig iron, of steel rails, of bridge work, of blooms and billets, of girders, beams and pillars, of armor plates and of ferromanganese, all of which are manufactured on a scale of exceptional, if not of unprecedented magnitude. Hence, no one who has proved the possession of superior capacity is overlooked, and no one is long continued in a superior position whose capacity is doubtful.

Another feature of the Carnegie organization that strikes outsiders with admiration, and competitors with something akin to terror, is the fact that they are almost always fully employed. This is not a mere accident. It is the result of the most deliberate and settled policy, carried out with almost military precision and discipline. If any order is taken by another firm, no matter in what part of the country, or for what description of product, the agent of the Company in the locality whence the order was issued is peremptorily asked, Why was not that order secured for us? Orders must be got at whatever price. The general basis of the instructions given to the Company's agents is, "Your affair is to get the orders; the price is ours. You cannot be made responsible for the price, but you are held responsible for losing the order." In other words, the order has to be got at a good price if possible, but anyhow at a price. The trade of the whole American continent is treated in this way. The Company have agents everywhere—mostly young, active, capable men—who are paid a good salary, not by commission, who are in constant touch with headquarters, and who know that a more than ordinarily comfortable livelihood is attached to their activity on behalf of the firm.

But the most important and determining feature of the whole organization is the system whereby the Carnegie Company are enabled to produce more cheaply than any other firm on the American continent. This has been accomplished mainly by two agencies—the first, by securing the largest possible output from a given plant, and the second by securing the command of cheap raw materials. When Mr. Carnegie commenced the manufacture of pig iron at Pittsburgh, it was regarded as good work if 500 to 600 tons per week were got out of a single blast furnace. But by structural changes in the furnace, by a higher pressure of blast, and by other minor modifications, the production was increased step by step from 600 tons to 2,500 tons per week, and this with very little increase in the cost of labor. The consequence has been that pig iron can be produced to-day in the United States for almost one-third of what it cost only 25 years ago, and at this moment the Carnegie Company are producing hematite pig iron for $10.50, or 43 shillings and 8 pence per ton, which compares not unfavorably with the price at which iron of the same description can be produced in the principal districts of England. It has been the same with Bessemer and open hearth steel. When the Edgar-Thomson Bessemer works of the Carnegie Company were being built, Bessemer steel rails were selling at more than $132 per ton, and iron rails were about $80. But for about a year past Bessemer rails have been produced at the Carnegie works for about $17.50, or £3 5s. per ton, and have been sold at $20 to $24. This remarkable reduction has been partly a function of the reduced price of pig iron, partly of the greater output secured from a given plant and labor outlay. In other words, the output per unit of capital and wages has been trebled and even quadrupled. There is no concern in the world where production is carried on at such high pressure as at the works of the Carnegie Company. Every man is doing his "level best," and the system is so organized that the administration knows exactly what is being done by every man, whether on piece work or on day wages. Reports are made each day to the principals, which show specifically what each works, each furnace, and practically what each man has done. If the record of one day is not so satisfactory as that of another, explanations are demanded. If one works produces more from a given plant than another works, the better record is placed before the managers of the other as a standard to be aimed at. If one furnace fails to keep up to the standard attained by another, an inquiry is instituted as to the causes of the inferiority, and these are as speedily as possible got rid of. The very best that has been attained, or is believed to be attainable, by the command of practically unlimited capital, splendid organization and high skill and experience, is held up before everybody concerned as the standard to be aimed at, and nothing short of that is accepted as satisfactory. Under such a system, no one has a chance to fall much behind. The standard of quality and extent of performance are kept up throughout, and any falling away from that standard is at once detected, exposed and made a matter of animadversion. In a word, good and efficient service is rewarded all along the line, and bad and inefficient service is got rid of.

The chief interest of all this for European industrials lies in the threatened deluge of cheap American iron and steel. At the present time the Carnegie Company, paying almost double the wages that are paid in England, and drawing their chief supplies of iron ore from a distance of over 600 miles, are actually producing pig iron and steel as cheaply as they are being made in England. Hitherto the company have found sufficient orders at home to keep their works pretty fully employed. But the company continue to extend their operations. At this moment they are building two new furnaces, which will add about 5,000 tons, or 260,000 tons a year, to their output—almost as much as the largest output of any individual works in Great Britain, excepting perhaps two of the largest only. If the American market does not absorb this increased production, it is almost certain to be thrown upon the European markets—or, at any rate, on the Canadian and South and Central American markets, where England has hitherto had the principal share of the iron business. The policy of the organization is not likely to allow considerations of price to interfere with this result, and the profits which are realized at home are good enough, as a rule, to allow of a large remainder being sold elsewhere, if need be, at a loss, so long as the cardinal requirement of having the works fully employed is observed. The most formidable danger confronting the greatest of our industries at the present time is that threatened by the recent development of works established at a distance of several hundred miles from the American seaboard and controlled and administered by a single brain, which appears to the outside world to be enjoying the ***dolce***

far niente due to an exceptionally busy and successful life at the ancient seat of the Sackvilles in the county of Sussex, surrounded by vestiges of a now extinct iron industry, the collective products of which would hardly amount in a century to as much as the works which he has built up are producing every month.

Drawing-Office Methods.

By Mr. S. E. McNair, in *Engineering*.

In the following article I do not undertake to give the best methods yet devised, but only to describe the best I have met with in my own experience.

Making Drawings.—A standard size for finished drawings should be fixed once for all. For most mechanical drawings double elephant (40 inch by 27 inch) is the best size; a larger standard sheet should not be adopted without a very good reason.

The old-fashioned system of inking in the original drawing, and keeping it for reference, is perhaps more satisfactory than any other. The order will then be as follows: The draughtsman should complete his drawing in pencil, filling in the dimensions. A tracer will make a copy of it, and the dimensions on the tracing will be checked by another draughtsman. The tracing may now be blue-printed, and at any convenient time the original can be inked in and colored. Checking the tracing will, of course, verify the dimensions on the original. Each separate dimension should be legibly ticked to show that it has been checked, and those not drawn to scale should be underlined in red. In some offices it is the custom only to complete the tracing, keeping that as the standard for reference, the drawing being left in pencil without any dimensions marked, and, being of no further use, it need not have number or title. This is certainly the most economical method, if not the most permanent. The tracings, before being stored in drawers, should be encased in an improvised portfolio, made out of an old sheet of drawing paper doubled in half, ten tracings in each. This will prevent damage in getting in and out.

Linen may nearly always be used instead of paper for tracings, the slight difference in price being far outweighed by the increased durability. A tracing which takes a day to make would cost for material 10d. or 5d., and for time, at, say, 20s. a week, 3s. 4d. Total cost, paper, 3s. 9d.; cloth, 4s. 2d.

Tracings should never be sent into the shops, and ought not to be colored. They should be considered simply as a medium for making photo copies, blue or white.

Freehand section lining, and the liberal use of stencil plates for the different metals, will serve to make blue prints as intelligible as colored white copies, surfaces to be machined being marked with a red pencil. The section lining should be done the last thing, and the lines ought never to be drawn through figures written over a sectional part, but, being stopped off all round, will leave the dimension in a clear circular space. Alterations can be written with soda and water, which must be blotted immediately, and washed over with a wet brush. Notes in red may be made on blue prints with a half-and-half mixture of red ink and soda water.

Before a drawing is taken from the board, and of course before it is traced, it must have a number and title. These should both be stencilled in ink, even if the drawing is to remain in pencil. This is important. The number to be at the left-hand bottom corner, one inch from either edge. The title also at the bottom, but to the right-hand side. Figures $\frac{3}{8}$ inch high may be used for the number, and $\frac{1}{4}$-inch letters for the title.

The drawing number (D. No.) may be the next one available in the register; any attempt to group numbers according to the job will make more trouble than it saves, unless the exact number of drawings required be known beforehand.

Each separate casting must have a pattern number (P. No.) distinctly marked both on drawing and tracing. This will not be confused with the drawing number, as it will soon reach a much higher figure. In machines of many parts the pattern numbers may follow continuously, but in small standard articles, such as plummer blocks, valves, etc., they can be better distinguished by letters, as, for example, shell P. No. 185, valve P. No. 185A, spindle P. No. 185B, etc. This will save trouble in the pattern store.

Parts that are drawn out in detail may be distinguished by their pattern numbers, but all the pattern numbers should appear on the general arrangement drawing. Wrought iron parts may have a letter instead of a pattern number, which need not be entered in the register, as it merely serves to indicate the position of the wrought iron detail on the general drawing, and will also be referred to in the specification.

Registering Drawings.—The register is a most important book, and needs to be well planned and well posted. It will give a complete biography of each drawing, with its family connections, and will prove a most valuable record.

The key to an efficient method of registering is a double entry system, and should be arranged as follows:

The book will begin with an alphabetical index. Then about 40 pages ruled for consecutive drawing numbers, with eight columns for (1) number of drawing; (2) title; (3) date when finished; (4) when traced; (5) blue-copied; (6) sent to shops; (7) returned from shops; (8) remarks.

The next 200 pages will be reserved for a digest of the preceding, corresponding to a ledger account, and ample space must be left for the entries. Heading the page will be the title of the job, and beneath this three columns for D. Nos., description, and P. Nos. A specimen entry will serve to explain the arrangement:

10-*Inch Screw-Cutting Lathe.*

D. Nos.	Description, Titles.	P. Nos.
70	General arrangement, 10-inch lathe.....	875–902
71	Cast details, 10-inch lathe.....	875–891
	Bed.....	875
	Headstock.....	876
	Cone pulley, etc. (to P. No. 891)	877
72	Forged details, 10-inch lathe.....	A—M
	Mandril.....	A
	Tailstock screw.....	B
	Leading screw, etc. (to P. No. M).....	C
73	Slide rest for 10-inch lathe.....	892–902 and N—T
	Saddle	893
	Cross slide, etc. (to P. No. 902).....	894

It may seem that so many entries will involve a large amount of work, but in practice it will not be found a very serious matter, and an efficient system of registering drawings will save much time in the end.

Storing Drawings.—Let it be taken as an axiom that no drawing must ever be rolled. All designs should be kept in drawers specially

Fig 1

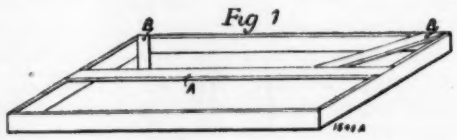
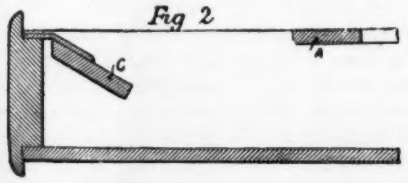


Fig 2



made for the purpose. Size, 2 inch larger each way than the standard sheet, and $2\frac{1}{2}$ inches deep inside. Each to contain not more than 25 drawings, as, if there be a larger number, it is difficult to pull out the lower ones without tearing. About half way from the front, a strip of wood, *A* (Fig. 1), $2\frac{1}{2}$ inches by $\frac{5}{16}$ inch, nailed at the top of the drawer, serves to keep the sheets in place, while the diagonal pieces *B B*, of same section, prevent the back corners from curling up. A hardwood flap *C* (Fig. 2), with a leather hinge, serves the same purpose in front. When drawings are kept in this way, the advantage of having numbers and titles near the lower edge is evident. It is only necessary to raise the left-hand corners of the drawings in order to find the one required. The drawings should be stored in strictly numerical order, any laxity in this respect leading to confusion. The numbers may be stencilled on a paper label outside each drawer, 1—25, 26—50, etc.

Tracings should be kept in the same way, only there may be fifty in a drawer. Tracings also, when kept for photo purposes, should not be rolled.

Standard Details.—Small lists, uniform in size, should be drawn up, traced and blue printed; and each draughtsman should have copies. Bolts and nuts, with their diameters, strengths, weights, areas, etc., will be the first and most important. All the different screw threads should be tabulated for reference in the same way; diameters of gear wheels for different pitches and numbers of teeth, and principal dimensions of standard bearings, hangers, etc., will be added to the series from time to time.

Stencilling.—A fairly complete outfit of stencil plates will be found a

great convenience, and may consist of plates for "Scale full size," "Scale half size," "Scale 3 in. = 1 ft.," "Cast iron," "Wrought iron," "Steel," "Brass," "Gun metal," P. No., D. No., Drawing No., "Plan," "End elevation," "Side elevation," "Section on line," "Not drawn to scale," Machined all over," "Two to this, one as shown, and one to reverse hand." There should also be two complete alphabets and sets of figures of different sizes.

It is obvious that the use of the above plates can be much extended by omitting one or two words. Thus "Scale 3 in. = 1 ft." will serve for any scale by leaving out the 3 in;, and writing in afterwards the desired scale. "Two to this"—may do for any quantity other than two in the same way.

The best brush is quite small, with rather soft, short bristles, all the same length. The ordinary Indian ink should be used, and a small board or piece of hard leather may be kept for rubbing the brush upon. This has been found more satisfactory than the prepared ink in tins.

Specifications.—A specification, or list of parts for each job, should be supplied to the foreman at the same time as the drawing. Upon this each separate part should be described, and its drawing number and P. No. indicated. A rather more elaborate system, which, however, is well worth adoption, is to have specially ruled specification paper with one wide column for "Description," followed by narrow columns for, 1. Order out; 2. Pattern; 3. Cast; 4. Forge; 5. Machine; 6. Other processes; 7. D. No.; 8. P. No. Against each piece under the heading "Description" a "0" is placed under the name of the different processes to which it must be subjected, and over this the foreman makes a cross when that process has been carried out. Thus he can not only see at a glance the actual condition of any job, but can also form an idea of how much work is ready for the different departments.

There may be few firms which can adopt the above methods in their entirety, and if the writer has failed to describe many systems in vogue, it is because he has confined himself to such as have come under his own observation.

Walker's Gas Retort Lid.

On June 26th, U. S. Letters Patent (No. 522,137) were granted to Mr. C. C. Walker, of Donnington, near Newport, England, for an improved lid for gas retorts. Using the words of the specification:

My invention relates to the lids of retorts to which lids a sliding movement is imparted with the object of causing the lid to rub on the rim of the mouthpiece when it is closed and opened. Means for this purpose are described in the specification of United States Letters Patent No. 331,102, dated November 24, 1885, and it is the object of my invention to provide means whereby a more efficient rubbing action of the lid upon the rim of the mouthpiece is insured. To effect this I make the eccentric boss which is upon the screw and which engages in the corresponding recess in the lid of less depth or thickness than hitherto, or than the depth of the recess, and I place a flexible device such as a coiled or bow spring or springs between the lid and the cross bar, which device keeps the lid in contact with the rim of the mouthpiece during the final portion of the operation of the screw in closing the mouthpiece, and also during the first portion of the operation of the screw in opening the mouthpiece, and as during such times the eccentric boss gives an eccentric movement to the lid, a very efficient rubbing of the lid on the rim of the mouthpiece is insured, as the lid is by the flexible device or spring or springs caused at such portions of the operation of the screw to keep in contact with the said rim.

Fig. 1.

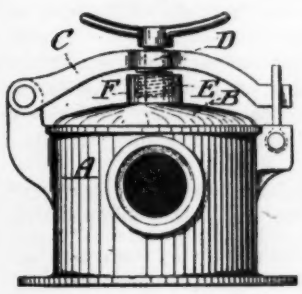


Fig. 2.

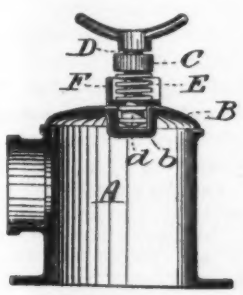


Fig. 3.

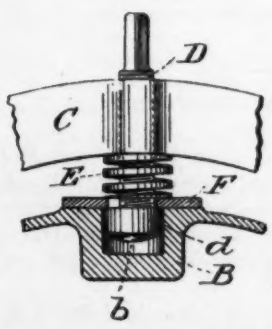


Fig. 4.

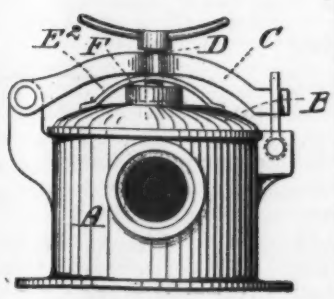


Figure 1 is a plan and Fig. 2 is a section of a retort mouthpiece and lid provided with my invention, and Fig. 3 is a sectional view of part thereof drawn to a larger scale. Fig. 4 is a plan showing a different kind of spring.

A is the retort mouthpiece.

B is the lid.

C is the cross bar, and *D* is the screw passing through the said bar for pressing the lid on to the mouthpiece. Upon this crew is the eccentric boss *d*, which engages in the recess *b* in the lid. The said boss *d* is o less thickness or depth than the depth of the recess *b*.

E is a coiled spring placed between the lid *B* and the cross bar *C*.

F is a plate or box which takes the bearing of one end of the spring, the said plate or box having an opening in it of sufficient size to allow of the working of the screw *D*.

In Fig. 4 I have shown a bow or flat spring *E* as taking the place of the coiled spring *E*, the other parts being like and lettered similarly to those shown in Figs. 1, 2 and 3. The spring *E* keeps the lid in contact with the rim of the mouthpiece during the final portion of the operation of the screw in closing the mouthpiece, and also during the first portion of the operation of the screw in opening the mouthpiece, so that the action of the eccentric combined with that of the spring gives a very efficient rubbing action as aforesaid.

I claim—

The combination with the retort mouthpiece and lid and cross bar and screw of an eccentric on the screw engaging in a recess in the lid, the said recess being of greater depth than the thickness of the eccentric, and of a yielding device between the lid and the cross bar, substantially as and for the purpose hereinbefore described and illustrated by the accompanying drawings.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, July 10, 1894.

The Gas Institute.—Incandescent Gas Light.—Gas Companies and the Hardware Trade.—A Gas Driven Tram Car.

The event of the past month was the meeting of the Gas Institute, which was held at the Westminster Town Hall, in London, on the 19th, 20th and 21st ults., and was in every way a success. The increasing attendance has rendered it necessary to secure fresh quarters for the London meetings, which were formerly held at the rooms of the Institution of Civil Engineers. For some years past there have been complaints of crowding in the lobbies and staircases, and the Council have been fortunate in securing the use of a building possessing approaches, etc., that are adequate to their large and increasing requirements. If evidence as to the position acquired by the Institute in regard to the profession generally was needed, it is furnished by the fact that no less than 53 new members were admitted at this meeting, exclusive of five late applications, thus raising the list of members to over 600. The names on this list are not confined to gas engineers or managers, but include chairmen of gas committees, directors of gas companies, secretaries, and other interested officials, so the Institute can claim to be something larger than a mere Society of Gas Managers. It is a fair representation of the British gas industry, or of a very respectable section of it at any rate. A full programme was provided, including thirteen papers, and although the businesslike President—Mr. John West—insisted on punctuality throughout, it was evident that some of the discussions were curtailed in order to get through the whole. One interesting feature of the proceedings was the presentation of the Birmingham Medal to Mr. W. A. Valon, of Ramsgate. No one in our profession, although there are many who have done excellent work, could make out a more worthy claim for that

honor. Mr. Valon has put at least half a dozen good papers, dealing with points possessing novelty and importance, before the Institute. He has left a most exemplary record of a year's Presidency. Indeed, few, if any, have done more for the Institute and for the profession in general than Mr. Valon. May he live long to wear his medal.

From the hearty and unanimous support accorded by the members to their respective Council, it is evident that the policy adopted by the executive during the last few years, is generally acceptable. It has been felt that the members were entitled, in return for their subscriptions, to something more than the right to attend the meetings and subsequently to the receipt of a copy of the transactions. A reference library is being gradually formed, there is a technical committee who are regularly engaged upon some topic of present moment to the profession, and a further development, now introduced for the first time (although it was first suggested to the Council some three years ago), is that of keeping a watch upon proceedings in Parliament, and such changes or additions to legislative enactments as may be proposed from time to time, so far as they are likely to concern the interests represented by the Gas Institute. A detailed reference to the programme would be too much to attempt, but Mr. Newbigging's views on the best and most suitable quality of gas for general supply, Mr. Stelfox's account of a winter's working with the water gas process at Belfast, and Mr. Chester's paper on the construction of retort settings and furnaces, may be instanced as the prominent novelties that were brought before the meeting. The social and recreative portion of the proceedings included a reception followed by a dance, at which a brilliant gathering were welcomed and hospitably entertained by the President and Mrs. West, and a day excursion to Oxford.

In connection with the meeting, many of the members availed themselves of an invitation to visit the works of the Incandescent Gas Light Company and inspect the manufacture of the special kinds of gas burners to which this name has been given. For some time past there has been evidence that the incandescent system has gradually been emerging from the experimental chrysalis into the larger development of everyday use. And the prejudices of those who may yet be inclined to regard it as more fitted for the laboratory than for the working or living room, and better adopted for the use of the scientist than for the ordinary user of gas, were totally dissipated by the information placed before them on that occasion. Not only is the cost of the lamps and the mantles being reduced, but their durability and the color of the light afforded by them is gradually coming under control, the experience gained by actual practice being valuable in each direction. A few weeks since, in connection with an exhibition of gas appliances, I had occasion to conduct some tests as to the consumption of gas, by attaching some of these burners to an experimental meter, and the result was that an excellent light of 40 or 50-candle power, equal to that afforded by the best make of oil lamps, was obtained at a cost of one-tenth of a penny per hour for gas. The burner and meter were placed on view, and a large label, "10 hours for one penny," attracted attention. The result was extremely satisfactory.

The general policy followed by gas companies in the matter of encouraging the use of gas for purposes other than lighting, by letting stoves on hire at moderate rates, or by selling them at little more than cost, is attracting some attention amongst the ironmongering and hardware trade. The cause of this is simply trade jealousy. There appears to be an idea that for every stove brought into use, a tax of "the usual trade discount" is due, and should be paid to some local retail trader; and that default of this regulation is an offence against the trade. So it is proposed that gas undertakings should be approached by representatives of this industry with a view of coming to some arrangement that would prohibit the sale of gas appliances at less than the good old-fashioned catalogue price, and also prevent the letting on hire at rates so low as to be likely to interfere with sales. It is the old tale. There is no disputing about who is to go out and fight. It is when the spoils are divided that the claimants turn up. So the hardware trade had nothing to say when the gas companies were spending money on exhibitions and cookery demonstrations. It is now when the results of that enterprise are becoming evident that they want to enter on the scene. But they have overlooked the fact that the consumer or purchaser would have something to say in respect to any arrangement such as they propose, being in that respect in much the same position as those who urge the justice or otherwise of uniform as compared with differential rates for gas, as if there was anything like a free choice in the matter. It is not likely that any company will throw 10 per cent. discounts amongst the consumers with a free hand, and scatter 20 per cent. rebates, just for the fun of the thing. They are only human, after all, and if anyone can show them how to sell gas at a uniform price, to sell stoves at prices that leave them the whole trade discount, and to let or hire at rates that afford a handsome profit on the hiring department—if anyone can show them how to do this, and at the same time retain their hold on the goodwill of the consumer, there are few who would object to fall in with the idea. Our friends must go to the consumers, and convince them that their views are right, and if the purchasers are willing to pay 20 per cent. or so more for the first cost, or about double the present hiring rates, the gas companies, like Barkis, "are willin'." There are few who would take up the responsibilities connected with pushing the use of gas appliances, if they were satisfied that others would do it properly and efficiently. If the tradesmen are doing an adequate business in this direction, the gas suppliers are only too glad to let them alone. But the matter has been forced upon gas companies, by repeated experiences, that no one cares to do it for them. For many years the hardware trade had the whole field in their own hands, and how many of them ever took the trouble to personally superintend the fixing of a gas stove, or to find out whether it was a success when fixed? Gas companies, finding that no business worth the name was being done, took the matter in hand, with the efficient aid of the manufacturers of gas appliances, and established the trade that at present exists. Having so established it, they are not likely to be convinced that other tradesmen have any right to interfere or to regulate the terms upon which business is to be done.

A syndicate has been formed for introducing the use of compressed gas as a motor for driving tram cars in England. And a compressing plant with a set of five cars has been fitted up on the Croydon and Thornton Heath Tramway Company's line in the neighborhood of London. It is stated that with ordinary town gas at 3 shillings per 1,000 cubic feet the cost of carrying 40 passengers does not exceed 1 penny per mile. If the working of this set of apparatus proves successful, there is every reason to anticipate a future for the use of gas in this manner. The advantages as compared with horses, with electricity, or other forms of stored energy such as compressed air, etc., are obvious.

The system used is that devised by Herr Luhrig, of Dresden, and it has been satisfactorily operated in Germany. The charging station is situated at one end of the line, and it comprises a storage vessel of steel, 4 feet diameter and 25 feet long, which is charged with gas compressed to 10 atmospheres or 150 pounds per square inch. The work is effected by a set of pumps actuated by an 8-horse power gas engine. The driving machinery on the cars is situated under the seats and the floor, and comprises a specially designed Otto gas engine, fixed on one side, a receiver on the other, and two other receivers placed transversely. These will contain a sufficient store of gas to allow an 8-mile run, and can be recharged to a pressure of about 8 atmospheres in two minminutes. The Board of Trade will not allow trains to run at more than 8 miles per hour, and the machinery is arranged to conform to this rule. The cars are of the usual construction, except that the body is carried rather high to afford room for the machinery, and they are rather lighter and smaller than the usual pattern of horse car. They are 17 feet long, including a 3-foot platform at each end, and will carry 16 inside and 12 outside passengers. The stopping, starting and rate of speed can be controlled from either end, and the machinery is concealed from view by suitable screens.

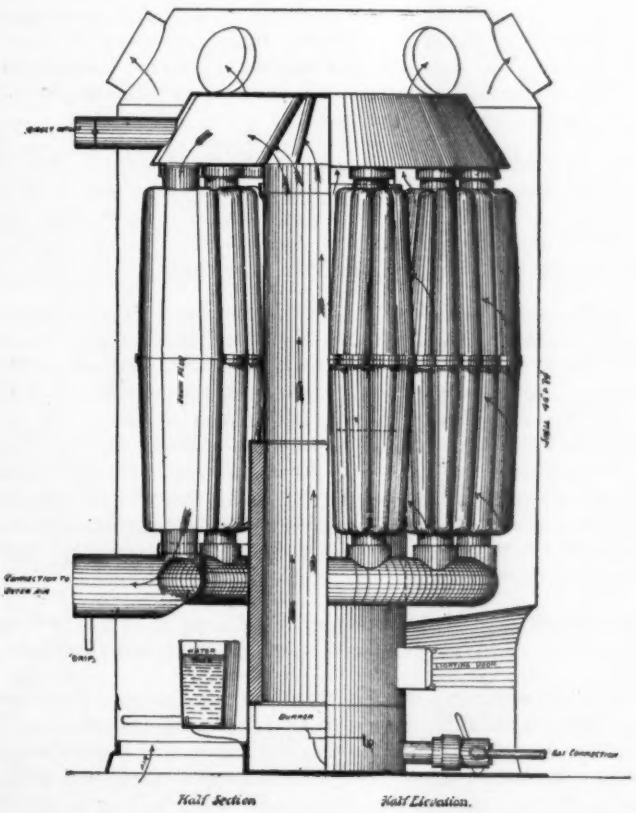
There are two special advantages that are bound to tell in favor of gas tram cars. The first is that they are practically self contained and perfectly independent of each other. The recharging is effected expeditiously and without waste. And the second is very important to tramway proprietors who are especially anxious to reduce their working expenses as low as possible. It is that the consumption of gas is proportioned to the energy supplied. There is nothing running or being used when the car is stopped, and further than that, a car running with 20 passengers will not use so much gas as one with 40. The consumption of gas can be stopped entirely when required, as, for instance, when running down an incline. In many parts of the country a supply of gas can be obtained at 2 shillings per 1,000 cubic feet, or even less; or a special low priced gas could be supplied if the scale of operations warranted the outlay.

The Vulcan Hot Air and Hot Water Furnaces.

The accompanying illustrations show the Vulcan Hot Air and Hot Water Furnaces that are designed to the use of gas solely for fuel, and are being put on the market by a well-known New York firm. They are constructed entirely of cast iron, which warrants their durability, as it will stand the corrosive action of the sulphur compounds that are often found in natural gas.

The hot air heater consists of a central, round, brick-lined flue with the gas burner in the back. This flue extends to the top of the furnace, connecting directly into the center of the dome. The dome, which is cast in one piece without joints or bolts, has 10 air slots through it from bottom to top that extend from its periphery nearly to its center. Ten

vertical corrugated tubes connect the dome with a circular hollow outlet ring that has an outlet for products of combustion. The whole is incased in the usual galvanized casing. There is an opening with damper from the dome connected with the pipe to the chimney, that is used only when lighting the gas to start the draught up the chimney when it has



Half Section. Half Elevation.

not been used for some time, and to prevent accumulation of gas in the furnace. The gas burner is connected so as to intimately mix the gas and air, using the least amount of air necessary to effect the complete combustion of the gas. The combustion is completed in the hot fire-brick lined chamber, and the highly heated products ascend directly to the top of the furnace, imparting little of their heat until they reach the dome. This highly heated column of gases makes a strong draught, sufficient to draw in the air needed for combustion and to force the products into the open air. As intensity of draught varies nearly as the product of the height into the difference of temperature, the 4½-foot column of hot gases at 1,800° F. would give as strong a draught as a chimney 27 feet high at 300° F.

The products pass through the dome between the air slots, and thence down through the corrugated side tubes, and as cooled descend to the outlet ring and pass into a pipe directly to the open air, or to a chimney as preferred. A large part of the aqueous vapor resulting from the combustion of the hydrogen in the gas will be condensed in the lower part of the corrugated tubes and outlet ring, and will pass through the small pipe to the cellar drain, or a vessel as preferred. The amount of water produced from the combustion of various gases is about as follows per 1,000 cubic feet :

London coal gas	63 lbs.
Natural gas	93 "
Lowe water gas, carbureted	48 "
Granger " "	51 "
Loomis water gas, uncarbureted	33 "

The taking out of a large portion of the water at this point decreases the weight and volume of the products of combustion, and experience has shown that they can be discharged through a chimney at a low temperature without depositing moisture. There is a considerable increase in efficiency also, as hydrogen burning to water gives off over 18 per cent. more heat than when burning to steam. The cooling of the products of combustion to a low temperature is greatly assisted by the fact that the incoming cold air to be heated passes, first, over the outlet ring and lower ends of the corrugated tubes, thus subjecting the products of combustion to the lowest temperature in the furnace as they pass out. With the hot air passing out from the dome, or hottest part of the furnace, and the products of combustion passing out of the coolest, the highest possible efficiency is reached. The hot water heater is constructed on the same general principles as the hot air heater. The products of combustion ascend through a highly heated brick-lined flue, impinging directly into the bottom of the dome, then descending through the section to the outlet below lower section. The return water passes through the two lower sections, then up, and through the three upper sections to the dome which has the supply outlet in its center. In this, as in the hot air heater, the products of combustion are subjected to the lowest temperature in the heater as they pass out. As the only water joints are in the columns outside of the heater they are always in sight and easily made. The sections are alike, and size of heater can be changed by increasing or decreasing number of sections. In applying gas to househeating furnaces, the following difficulties have been encountered.

In using ordinary up-draught furnaces the tendency of the hot gases is to take a direct course up through the heater to the stack without imparting a fair share of its heat to the heater. In these heaters the stack temperature is always very high, even when the heater is doing much less than its rating. When a small amount of gas is being used in a large heater, and the products of combustion are brought below 212° F., the water vapor produced by the combustion of the hydrogen in the gas condenses in the heater even to such an extent that it drips back into the burner; also, is carried along, condensing in the stove pipe and in the chimney. The condensation in the chimney gives very serious results, as the moisture penetrates through the sides of the chimney, staining the walls.

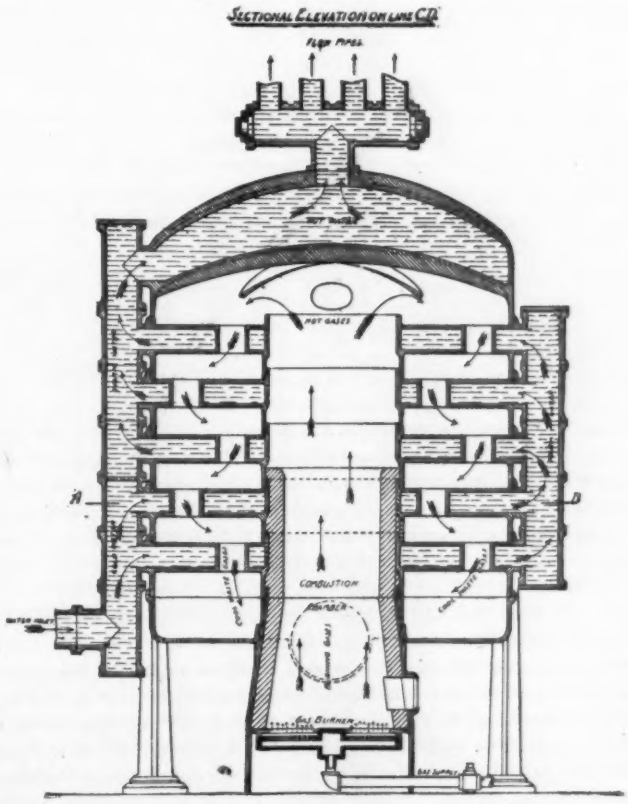
Two methods have been used for getting rid of the above difficulties, and both entail a large loss of efficiency.

1st. Discharging products of combustion from furnace at so high a temperature that condensation will not take place until the products have reached the outer air at the top of the chimney.

2d. Supplying at the burner a much larger amount of air than is needed for combustion. This air being heated in its passage through the furnace, will absorb the vapor and carry it to the top of the chimney, provided the temperature is not too low.

While the stack temperature is lower by this method, the volume of the products of combustion is increased, and no economy is effected. Sometimes air is admitted by check draught in the stove pipe close to the heater, instead of at the burner, but the net result will be the same as in the latter case, for the products, when they meet the incoming cold air at the check draught, must be hot enough to raise the temperature of the air sufficiently to carry it to the top of the chimney.

The Vulcan heater is so designed as to abstract the greatest amount



of heat from the products of combustion, and to discharge these products into the open air even when reduced to the lowest possible temperature. The past winter a Vulcan hot water heater, using illuminating water gas in New York, and discharging the products of combustion at 90° to 120° F., into a chimney 50 feet high, with no other connection, gave no trouble from moisture, and over 25 pounds of water per 1,000 feet of gas were collected at the heater.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

AT a special meeting of the Concord (N. H.) Gas Light Company the Hon. Lyman D. Stevens was elected without opposition to the office of President, succeeding therein the late Col. J. B. Sanborn.

MR. SAMUEL A. MARCH, Manager of the Northwestern Globe Gas Light Company, died at his home in Minneapolis, Minn., some days ago. Deceased, who was born in Oakfield, N.Y., in 1840, went to Minneapolis in 1877, and served a term as State Senator (1894) from the Minneapolis district. He also served a term as Park Commissioner.

THE new holder for the Binghamton (N. Y.) Gas and Electric Company, which is being constructed by Messrs. R. D. Wood & Co., is to rest in a steel tank and is to have a capacity of 200,000 cubic feet. It is to be completed by October 1st.

AT the annual meeting of the Municipal Gas Company, of Albany, N. Y., the officers chosen were: Directors, Roswell P. Flower, E. C. Benedict, J. Howard King, Robert C. Pruyn, William McEwan, John E. McEwan, John E. McElroy and Anthony N. Brady; President, A. N. Brady; Vice-President, Robert C. Pruyn; Secretary and Treasurer, J. E. McElroy. A quarterly dividend of 2 per cent. was declared. Secretary McElroy, in speaking after the meeting about the business outlook, especially with reference to the effect on same of the new rate adopted for a fuel gas supply, said: "The increase in the use of gas since the price was reduced to $1.25 per 1,000 cubic feet for domestic purposes will not be known until the end of the quarter. This is the dull quarter for the use of gas, and then, too, the hard times will cause consumers to be more economical. Because of the cheapness of gas its more general use for cooking and heating purposes will ensue in the fall. The price of gas used for illuminating purposes remains at $1.70 per 1,000 cubic feet, but it will go lower in time." In the meantime it might be in order to say that the sale of gas stoves by the local firm known as the Albany Hardware and Iron Company is double that of a year ago.

THE Baltimore *American* says that the net earnings of the Consolidated Gas Company during the fiscal year just ended were over $900,000. The interest on about $6,400,000 amounts to something like $375,000, leaving enough to pay 5 per cent. on the capital stock. The Company had until recently in its surplus about $300,000 of its own consolidated fives. By a transaction with four prominent banking houses, these, which were all taxable, were all sold or exchanged for an equal amount of city 3½ per cents., which are not taxable. The deals were not with a syndicate, but were made separately, one transaction of $100,000 being done by a direct exchange of city 3½'s for consolidated 5's. The Company now has no more of its bonds to sell, and all on hand will be used for taking up and retiring the outstanding 6's. The saving by the exchanges and sales referred to is estimated to be equal to 2 per cent. on the amount of the 5's sold.

SECTION 32 of the revised licenses' ordinance of Los Angeles, Cal., provides for the payment of $100 per month "for carrying on the business of manufacturing and selling gas," and a like payment is to be exacted "for carrying on the business of producing and selling electric light."

EARLY this month President C. L. Torrance, of the Electric Light Company of Los Angeles, Cal., notified the consumers of electric light that the current for incandescent electric lighting would be shut off each night at 11 o'clock, which course was rendered necessary by the scarcity of coal supplies—a direct effect of the railway strikes.

IT is reported that the plants of the Shenandoah (Pa.) Water and Gas Company have been purchased by the Philadelphia and Reading Coal and Iron Company.

THE Berlin Iron Bridge Company, of East Berlin, Conn., has received the contract to cover the stone yard of M. C. Henry & Co., of New York, with an iron roof. A traveling crane will also be set up. The building is to be 50 feet wide and 100 feet long, and is to be constructed entirely of iron, the whole space to be controlled by the traveling crane.

THE Sioux City (Iowa) Gas Company is extending its mains to the adjoining suburb of Morning Side.

WE are indebted to "Observer" for the following: "At the annual meeting of the Gloucester (Mass.) Gas Light Company the following Directors were elected: G. P. Bradford, R. R. Fears, G. H. Perkins, Chas. S. Tappan and John A. Coffin. The Directors subsequently perfected the following organization: President, George R. Bradford; Clerk and Treasurer, David W. Low. The annual dinner of the Company took place at Turk's Head Inn, and among those connected with the Company who shared the feast were Messrs. D. W. Low, John A. Coffin, Chas. S. Tappan, Sylvanus Smith, George H. Perkins and Robt. R. Fears. The invited guests were Mayor Cook, Sylvester Cunningham, President of the Board of Trade; Joseph C. Shepherd, President of the Business Men's Association, and E. L. Norris, Manager of the Gloucester Electric Company. It is needless to add that the proceedings were of the thoroughly enjoyable sort."

THE proprietors of the Nanaimo (B. C.) Gas Company have determined to construct a gasholder, to rest in a brick tank, rated to contain 60,000 cubic feet. We understand that the Vancouver Machine Works will furnish the iron material and that the tank will be constructed under the superintendence of Mr. John Kinsman.

D. A. DAVIDSON has sued the Los Angeles (Cal.) Lighting Company for $50,000 damages for injuries received while in its employ. On November 6, 1893, he was directed to tar the roof of a sh d owned by the defendant, and while doing so one or more of the corrugated iron sheets covering it broke, throwing him to the ground, a distance of 14 feet. He alleges that he was a strong, healthy man at the time of the accident, but that now he is (and is likely to remain) incapacitated from performing work of any nature whatever. He claims that the Company knew the roof was insecure when he was ordered to tar the same, hence its responsibility. The Company's defense is lack of knowledge that the roof was unstable and plaintiff's culpable negligence.

THE new offices of the East Chester Gas Company, of Mount Vernon, N.Y., are located in the premises corner of Prospect and Third avenues.

A PECULIAR action at law is reported from San Francisco under recent date, where Messrs. S. J. Jensen & Co., furniture dealers, 21½ Ninth street, filed a cause against the San Francisco Gas Light Company. Some time ago the firm instructed the Company to furnish it with gas, which instruction was not carried out, and the firm now alleges that, under the provisions of a section of the Civil Code relating to corporations having business with the public, the Company, in failing to supply the gas as requested, damaged the plaintiff to the extent of $130. For this sum suit is now instituted.

THE new gas rates at Mechanicsburg, Pa., are: For illuminating purposes, $1.50 per 1,000 cubic feet; for cooking and heating purposes, $1.25 per 1,000.

THE Directors chosen at the annual meeting of the Greenfield (Mass.) Gas Company were: F. R. Allen, W. N. Washburn, W. A. Forbes, F. A. Pond and J. S. Safford. The Directors subsequently elected the following officers: President, F. R. Allen; Clerk and Treasurer, Dana Malone. A dividend of 3 per cent. on the preferred stock was declared, and one of 2 per cent. on the common was also ordered.

THE following is the schedule of rates recently adopted by the Board of Gas Trustees at Findlay, Ohio:

Cook stoves, 12 months, per month	$1.90
Heating stoves, 7 months "	1.90
Grates, " "	2.30
Residence lights "	.19
Business " "	.26
All day " "	.60
All night " "	.60
Saloon " "	.35
Meter rate per 1,000 cubic feet	.12

If paid before the 15th of the month, a discount is allowed.

IN our issue for last week brief mention was made of the fact that the City Council of Akron, O., had granted a franchise to the Akron Gas Company, and now, through the courtesy of Mr. Ernest F. Lloyd, Secretary of the Company, we are enabled to print the full text of the ordinance. It will be seen that the instrument permits the Company to charge $1.35 per 1,000 cubic feet, although the most influential local paper insisted that 90 cents would be the fair figure, quoting in support thereof the rates charged at Cleveland and Toledo, in Ohio, Grand Rapids, Mich., and other places. The Company, however, held out for the period of four months, during which the ordinance was being discussed, for a rate that would be fair to itself and not burdensome to its consumers, and permitted the authorities to examine its books, and its

business standing in general, to support its assertion that all it desired was fair play. The ordinance is as follows:

"An ordinance to amend sections 2, 3, 4 and 5 of an ordinance entitled 'An ordinance to provide the city of Akron with gas and to regulate the price of same, and to prevent injuries to gas fixtures,' passed January 3d, 1878.

"Section 1. Be it ordained by the City Council, of the city of Akron, that sections 2, 3, 4 and 5, entitled 'An ordinance to provide the city of Akron with gas and to regulate the price thereof, and to prevent injuries to gas fixtures,' passed January 3d, 1878, be amended so as to read as follows:

"Sec. 2. That whenever said Gas Company, its successors or assigns, proposes to open any street, lane, alley or public ground for the purpose of laying down or repairing any gas pipe, before doing so it shall give notice thereof to the Board of City Commissioners or their successors, and during the progress of its work it shall not unnecessarily obstruct the passage of any such streets, lanes, alleys or public grounds; and, further, it shall within a reasonable time repair any such part of the street, alley or public ground as may have been broken or opened in such manner as shall be acceptable to the Board of City Commissioners or their successors; and in paved streets the said pavement shall be replaced and made good by the said Commissioners or their successors, and the cost of said pavement shall be paid to the city by the said Gas Company, which shall further be required, at the direction of the said Commissioners or their successors, to deposit such sum or sums as they may consider necessary. All excavations made in laying down and repairing pipe to be so guarded by said Gas Company as to prevent injuries to the public, and said Gas Company to be responsible for all damages that may be sustained by reason of insufficient guarding of said excavation.

"Sec. 3. That in consideration of the privileges granted to said Company, its successors or assigns shall furnish to said city, when required for any purpose, such quantities of gas as may be required, and shall charge a price not exceeding $1.20 per 1,000 cubic feet, and shall charge for all gas furnished to all other consumers a price not exceeding $1.35 per 1,000 cubic feet, all of which gas shall be of good quality and of not less than 20 candle power; saving and excepting, however, that should the total consumption of gas, public and private, as shown by the books of the said Akron Gas Company, exceed an amount of 40 millions of cubic feet per annum, the price of gas furnished to the city of Akron shall be reduced to $1.10, and to all other consumers to a price not exceeding $1.25; and said Gas Company shall at any time exhibit its books to the proper officers of said City Council.

"Sec. 4. That it shall be unlawful for any officer of said Company, its successors or assigns, to charge or receive from said city or any other consumer a sum not exceeding the rates per 1,000 feet fixed in the foregoing section; and for every violation of this section such officer or agent, on conviction thereof, shall be fined in any sum not exceeding $25.

"Sec. 5. When five or more persons on any street shall petition the Council that a gas main be laid on said street, and shall furnish a sufficient guarantee that a gross annual income of $100 shall be forthcoming to said Gas Company on each and every 500 feet of such main, the Council shall have the power to order the laying of a main on such street, and the Gas Company shall lay such main within a reasonable time, as the Council may order.

"Sec. 6. That sections 2, 3, 4 and 5 of said ordinance passed January 3, 1878, be and the same are hereby repealed.

"Sec. 7. This ordinance shall take effect and be in force for a period of 10 years from and after the first day of the month following the passage, legal publication and acceptance by said Gas Company."

THE proprietors of the Doylestown (Pa.) works have awarded a contract for the remodeling of the generating plant to Messrs. Janeway & Logan, of Philadelphia.

AN entirely novel proposition was recently made to the Board of Administration of Cincinnati by a concern bearing the title of the Cincinnati Illuminating Company. This Company controls the local rights for a patent incandescent gas burner, and the proposition of the Company is to equip all the gas posts in the electrically lighted districts of the city with the patent burners, keep them in repair and supply them with gas free of charge to the city. The Company furthermore agrees to erect signs of any pattern selected by the Board upon all of these posts free of charge. The return asked for this lighting service is permission to place advertising matter, not to cover more than twice the space of the street signs, on each lamp post. The representatives of the Company claim that the light service which they offer will so supplement the electric light service that Cincinnati will be the best lighted city in the world. They say, further, that there will be nothing unsightly or ungainly about their advertising signs, and they assert that the Company is prepared to give bond in any amount to carry out the proposed contract.

THE following is from the Cincinnati *Commercial Gazette* of the 19th inst.: "The famous case of the Cincinnati Gas Light and Coke Company against the city of Cincinnati, which was argued before the Circuit Court judges two weeks ago, on error from the Court of Common Pleas, was decided yesterday by the handing down of a divided opinion affirming the judgment of the lower Court, which was in favor of the plaintiff, and which places a burden of $387,000 on the city. The case has been in the courts over four years, and was first heard by Judge Outcalt. It was a suit to recover $23,054 due for gas furnished and repairs made during the months of May and June, 1890, the payment of which was refused by the city on the ground that the amount was not in accordance with Conover contract of 1841, which provided that gas be furnished to the city at two-thirds the lowest average rate charged for gas furnished to private individuals in five cities of the United States, namely, New York, Baltimore, Pittsburgh, Louisville and New Orleans. The cross-petition of the city charged that the figures upon which the plaintiff based its price were fraudulent, in that it figured only upon the price charged the cities named for gas sold for illuminating purposes, and that the city had overpaid the Gas Company since 1841 something in the neighborhood of $375,000. The decision, as handed down by the Circuit Court yesterday, affirming the judgment of Judge Outcalt, is as follows: 'The members of the Court who heard this case do not entirely agree as to the rights of the parties. Judges Shauck and Smith are of the opinion that the natural and ordinary meaning of the language used in the ordinance which, when accepted, became the contract, and the city and Conover, the assignee of of the Gas Company, was, as claimed by counsel for the plaintiff, in error; and that in accordance with its provisions the price of gas furnished to the city was to be determined by ascertaining the lowest price at which (such) gas was regularly furnished to private individuals in each of the five cities named, and dividing the aggregate amount thus produced by the number of cities (five), and two thirds of this quotient would be the price to be paid by the city. We do not see how otherwise the word 'lowest' is to have any force or effect. Judge Swing doubts whether this is the proper construction to be placed upon the language, for this reason, among others, that it would seem very improbable that Conover would ever have made so improvident a contract. But Judges Swing and Smith are further of the opinion that, conceding the foregoing to be the natural and ordinary meaning of the language used, it does not necessarily follow that the parties in this case must have their respective claims adjudicated, in accordance therewith. When the terms of a contract are ambiguous and obscure, the aim of a Court adjudicating upon it should be to determine what was the intention and meaning of the parties making use of the language, and the subsequent conduct of the parties acting under it often throws a flood of light upon, and is almost, if not entirely conclusive upon the question. We think that such is the fact here, and we are led by it to the conclusion that the language should have that interpretation, which the parties by their conduct have placed upon it for nearly a quarter of a century continuously, and with full knowledge of the question involved. The principle here stated was followed by this Court in the case of Kenney, assignee, vs. Evans, of Hamilton county, referred to by counsel for defendant in error, the opinion in which has not yet been published, but which decision is said to have been affirmed by the Supreme Court. In that case the language of the contract was much less ambiguous than that used in this and seemed on its face to clearly require a certain construction, but in view of the continuous conduct of the parties placing a wholly different construction upon, we are of the opinion that this is what the parties intended when they used the language, and so construed it, and this view, sharply presented, seems to have met the approval of the Supreme Court. But the doctrine is a familiar one and in this brief opinion we do not deem it necessary to cite other authority. Judge Shauck, however, is of a different opinion, and, while disposed to hold that the cross-petition of the city to recover the amount claimed to have been improperly paid on its construction of the contract can not be maintained, as it is a voluntary payment, yet thinks that the city in this action brought against it by the Gas Company to recover for the amount of gas furnished for the two months sued for, should only be held liable for the amount as ascertained and determined, according to the terms of the contract as properly construed, and that, as the judgment in favor of the city was rendered for more than it should have been, the Court of Common Pleas having sustained its construction claimed by the Gas Company, the judgment rendered should be reversed and a new trial awarded. But as a majority of the Court is of the opinion that the judgment should be affirmed, it will be so ordered."

THE AMERICAN GAS LIGHT JOURNAL

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MONDAY, JULY 30, 1894.

The Market for Gas Securities.

City gas shares are all weaker than at time of last reporting, and although the net loss in Consolidated is small—not over half a point—it is nevertheless a shrinkage, which in the aggregate means much. Since the adjournment of the Legislature, the stock has fallen off about 15 points, and the weakness is undoubtedly caused by the well-defined impression that New York will have dollar gas by next spring, at the farthest. Equitable is weak and uncertain, and Mutual is also wavering. The "financiers" who have the New York and East River Gas Company's "job lot" of securities in charge, give it as their opinion that the "ordinary shares" are worth 17½ to 18¼. Perhaps so; but not for our money. Standard preferred is featureless, at 80.

The Brooklyn situation is as ragged as ever, and the least said about it the better. Prices are fairly well maintained, though. Chicago gas is somewhat easier, but those who ought to know say that the charter recently granted the promoters of the Universal Gas Company (the Council passed it over the Mayor's veto) will be grist for the mill of the Chicago united companies. The stock looks to us to be a purchase. The opening to-day was made at 74¼. Baltimore Consolidated is steady, at 65½ to 66¼, and Bay State common is weak, at 13 to 13¼.

Painting the Forth Bridge.

According to an English contemporary, at this season of the year the painting of the great Forth bridge may be seen in full operation. During the winter and spring months the weather will not permit of such work being carried on, and it is, therefore, only during the summer and autumn that it can be accomplished with anything like safety and success. The whole of the structure receives a new coat of paint every three years, and this is carried out in sections, about one-third being undertaken each year. Last summer the northern approach viaduct and the north cantilever were successfully dealt with, while this year the southern approach viaduct and the south cantilever are being treated in a like manner. It is also intended to include in this season's work the two center girders, which will then leave only the Inchgarvie cantilever to be dealt with next year. Besides the painting, every part of the structure is carefully examined, and loose or defective rivets removed and new ones put in their place.

At the present time about 50 men are employed, and an endeavor is made as far as possible to retain the same men upon the work, as it always takes new hands some considerable time to become thoroughly at home in some of the aerial positions they are at times called upon to occupy. At first this work was attended with considerable danger, but very complete apparatus in the shape of small cages having now been provided, the men run very little risk even at the highest and most dangerous points. In fact, the present arrangements seem to work so well that for a long time no accident has been heard of. Some idea may be had of the immense quantity of material used in the construction of this bridge when it is mentioned that it requires about 50 tons of paint to cover it, and that the area to be so dealt with means something like 120 acres. Notwithstanding that since the bridge was opened about 200 trains have passed over it daily, the wear and tear are scarcely perceptible, and the inclinations and deflections are quite unchanged.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks.
16 WALL ST., NEW YORK CITY.

JULY 30.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	123¾	124
Central	500,000	50	100	—
" Scrip	220,000	—	100	—
Equitable	4,000,000	100	185	188
" Bonds	1,000,000	—	106	108
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	151	—
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern	.....	50	80	95
" Bonds	150,000	—	—	100
Richmond Co., S. I.	348,650	50	50	—
" Bonds	100,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	25	30
Preferred	5,000,000	100	80	—
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	103	107
Citizens	1,200,000	20	50	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co.	2,000,000	100	—	—
Bonds	1,000,000	—	—	—
Fulton Municipal	3,000,000	100	—	126
" Bonds	300,000		103	—
Peoples	1,000,000	10	—	70
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	98	100
Metropolitan	870,000	100	—	136
" Bonds (5's)	70,000	—	—	155
Nassau	1,000,000	25	—	155
" Ctfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	135	140
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Bay State Gas Co.—				
Stock	5,000,000	50	13	13½
Income Bonds	2,000,000	1000	60	—
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	78	—
2d " " "	3,000,000	1000	57	58
Buffalo Mutual, N. Y.	750,000	100	120	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	160	—
Chicago Gas Company.	25,000,000	100	74¼	74½
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	81⅛	81½
Consumers Gas Light Co., Jersey City	2,000,000	100	55	58
Bonds	600,000	1000	92	—
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	184½	187
Central, S. F., Cal.			90	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt.	11,000,000	100	65½	66¼
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.—				
Con. Bonds	.....	.....	60	—
East River Gas Co., Long Island City	1,000,000	100	—	—
Bonds	500,000	100	89¼	—
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
Hartford, Conn.	750,000	25	120	128
Jersey City	750,000	20	190	200
Louisville, Ky.	2,570,000	50	125	130
Laclede Gas Light Co. St. Louis, Mo.—				
Common Stock	7,500,000	100	16½	17
Preferred "	2,500,000	100	65½	68½
Bonds	9,034,400	1000	88	88½
Little Falls N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
New Haven, Conn.		25	200	—
Oakland, Cal.			42⅜	43
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	108
2d "	2,500,000	1000	104	105
Peoples, Jersey City	500,000	—	175	185
" " Bonds			—	—
Paterson, N. J.		25	99	102
Rochester, N. Y.		50	80	85
Preferred			90	95
Bonds			90	95
Syracuse, N. Y.	500,000	25	—	—
San Francisco Gas Co. San Francisco, Cal.	10,000,000	100	71	71½
Washington, D. C.	2,000,000	20	240	—
Wilmington, Del.	500,000	50	180	182

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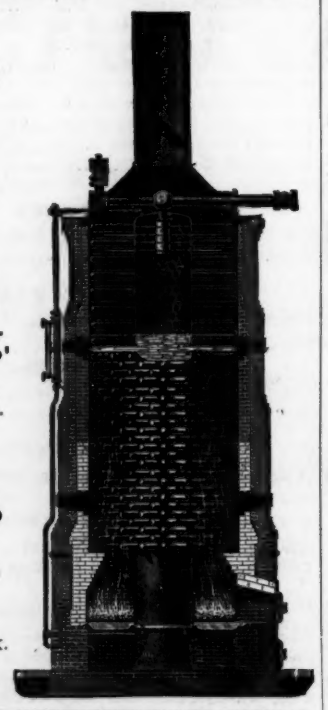

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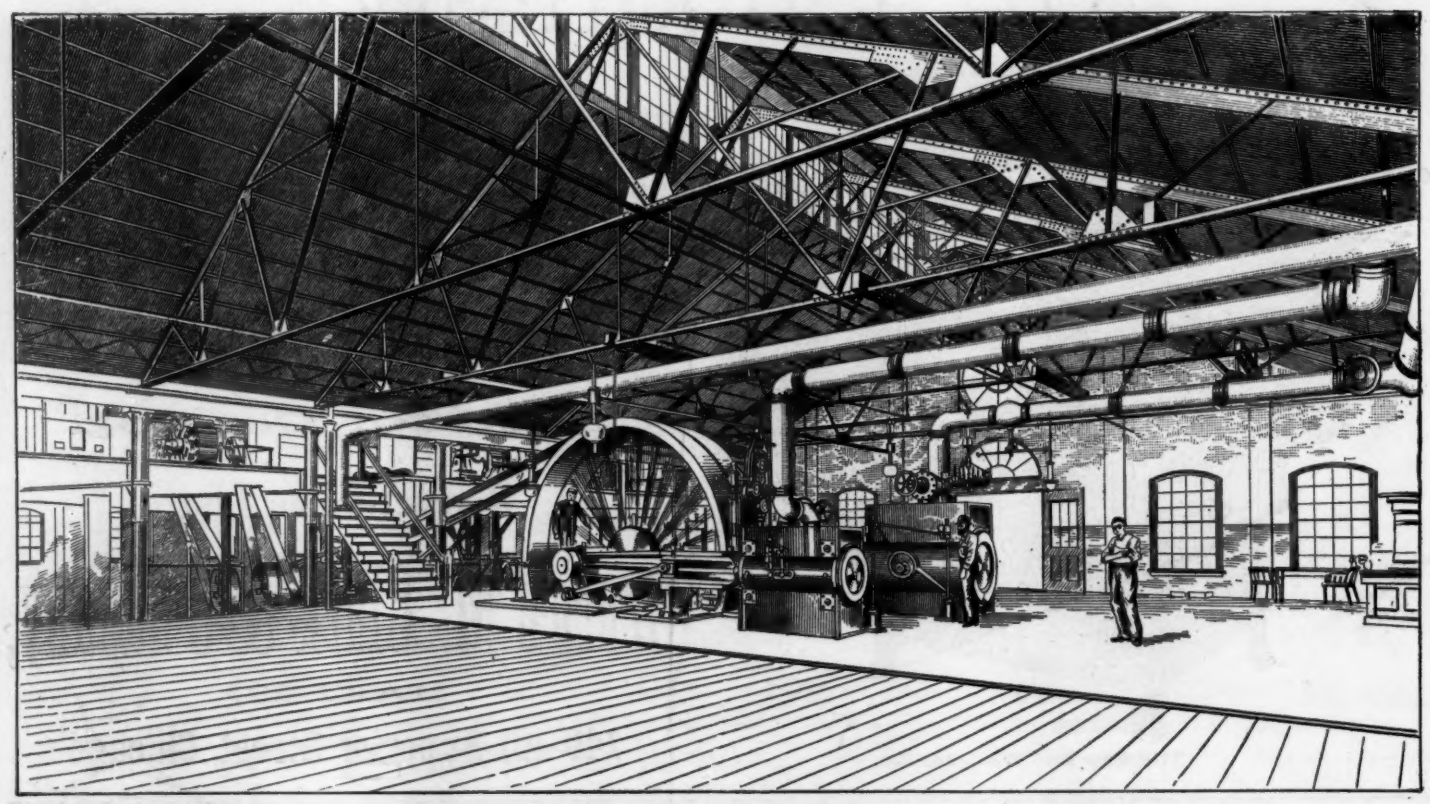

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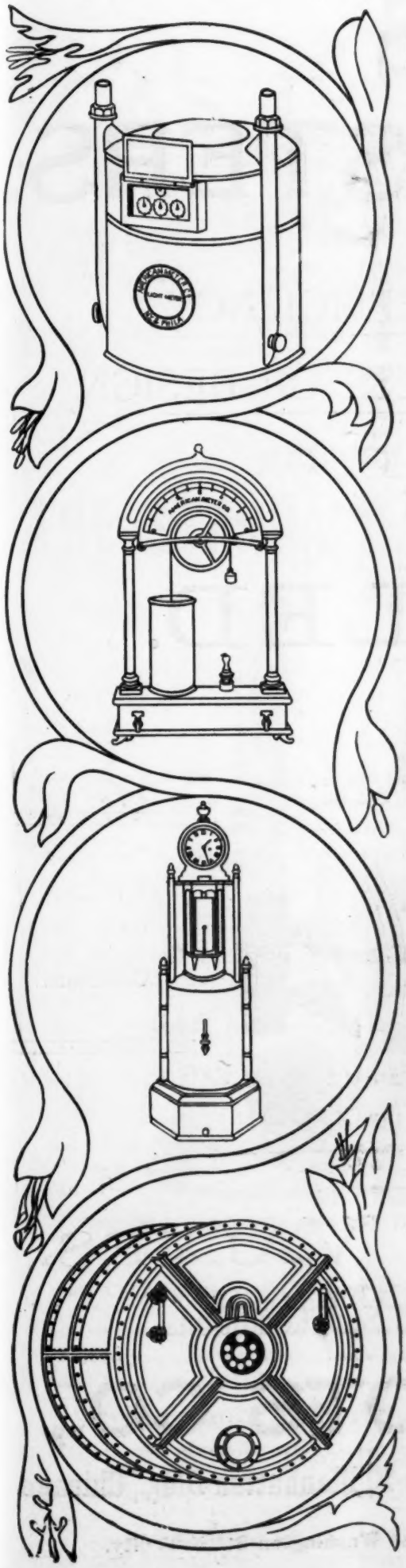

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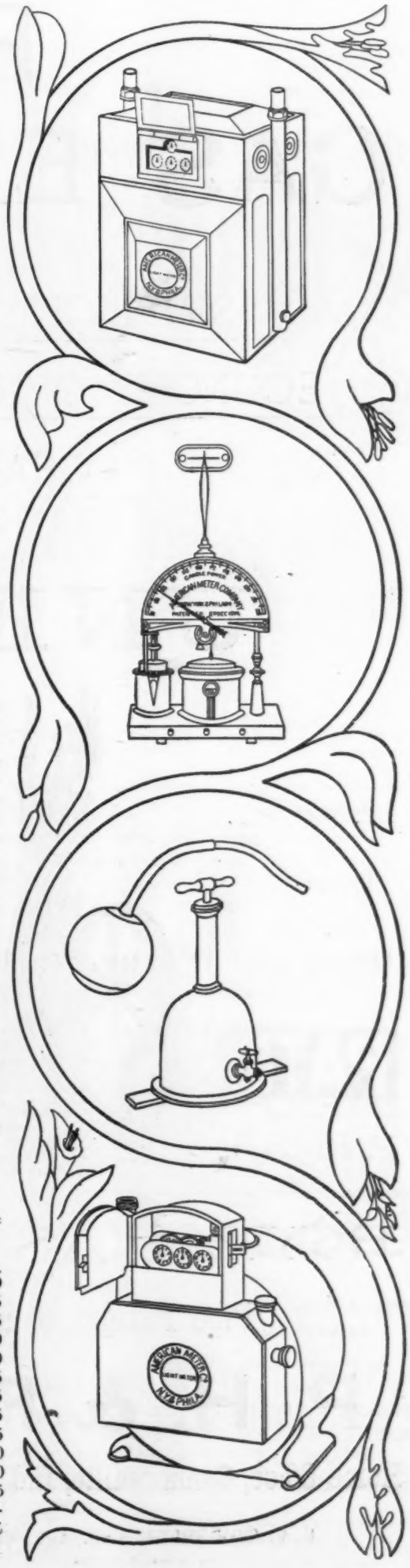
PUBLIC LIGHTING TABLE.

AUGUST, 1894.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Wed.	1	7.40 PM NM	4.00 AM	7.10	3.30
Thu.	2	7.40	4.00	7.10	3.30
Fri.	3	7.40	4.00	7.10	3.30
Sat.	4	7.40	4.00	7.10	3.30
Sun.	5	7.40	4.00	7.10	3.30
Mon.	6	9.00	4.00	7.10	3.45
Tue.	7	9.20	4.00	7.10	3.45
Wed.	8	9.50 FQ	4.00	7.10	3.45
Thu.	9	10.30	4.10	7.10	3.45
Fri.	10	11.10	4.10	7.10	3.45
Sat.	11	12.00	4.10	7.10	3.45
Sun.	12	12.50 AM	4.10	7.10	3.45
Mon.	13	1.50	4.10	6.55	4.00
Tue.	14	3.00	4.10	6.55	4.00
Wed.	15	No L.	No L.	6.55	4.00
Thu.	16	No L. FM	No L.	6.55	4.00
Fri.	17	No L.	No L.	6.55	4.00
Sat.	18	7.20 PM	9.00 PM	6.55	4.00
Sun.	19	7.20	9.20	6.55	4.00
Mon.	20	7.20	9.40	6.45	4.10
Tue.	21	7.20	10.00	6.45	4.10
Wed.	22	7.20	10.30	6.45	4.10
Thu.	23	7.20	11.10	6.45	4.10
Fri.	24	7.10 LQ	11.50	6.45	4.10
Sat.	25	7.10	12.50 AM	6.45	4.10
Sun.	26	7.10	1.50	6.45	4.10
Mon.	27	7.10	4.20	6.30	4.20
Tue.	28	7.10	4.20	6.30	4.20
Wed.	29	7.10	4.30	6.30	4.20
Thu.	30	7.10 NM	4.30	6.30	4.20
Fri.	31	7.00	4.30	6.30	4.20

TOTAL HOURS LIGHTING DURING 1894.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	244.10	January	423.20
February	195.30	February	355.25
March	206.20	March	355.35
April	169.40	April	298.50
May	162.10	May	264.50
June	135.40	June	234.25
July	146.30	July	243.45
August	162.20	August	280.25
September	174.10	September	321.15
October	211.20	October	374.30
November	221.00	November	401.40
December	245.30	December	433.45
Total	2274.20	Total	3987.45



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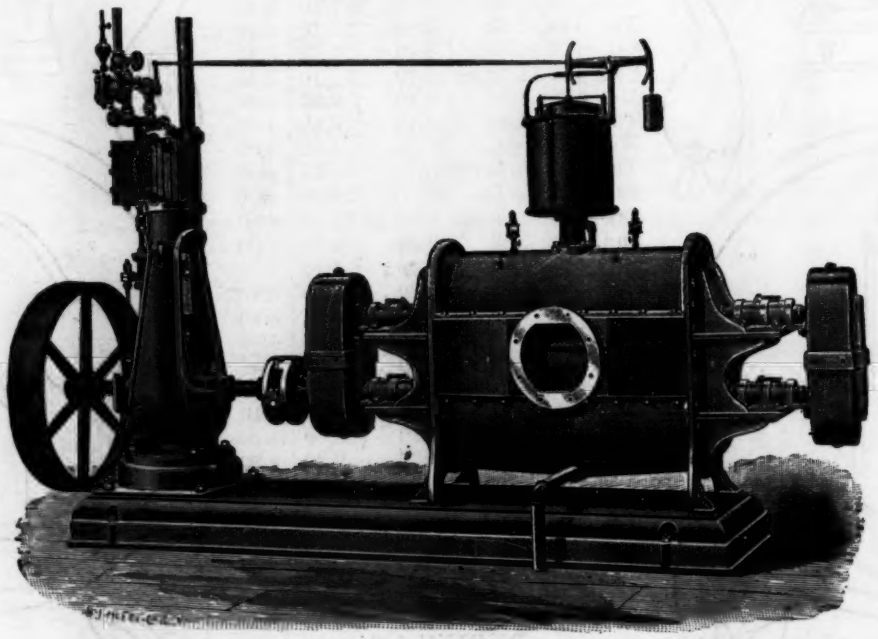

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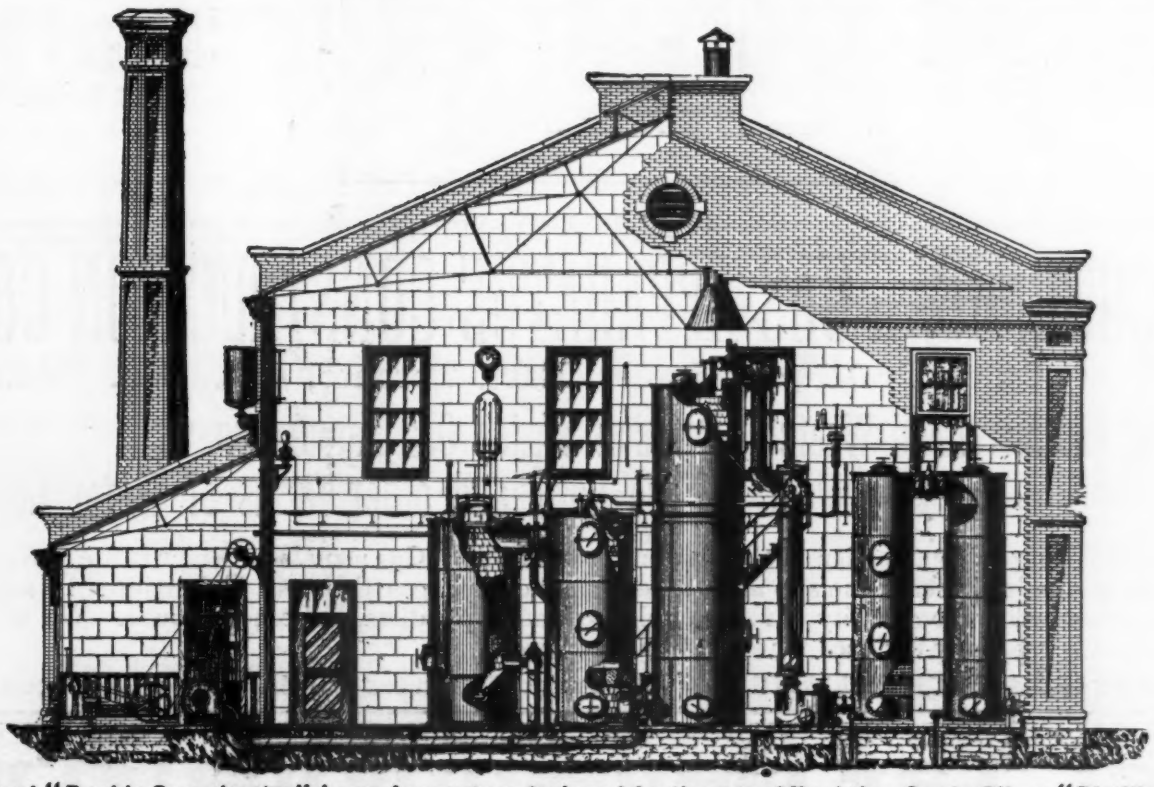

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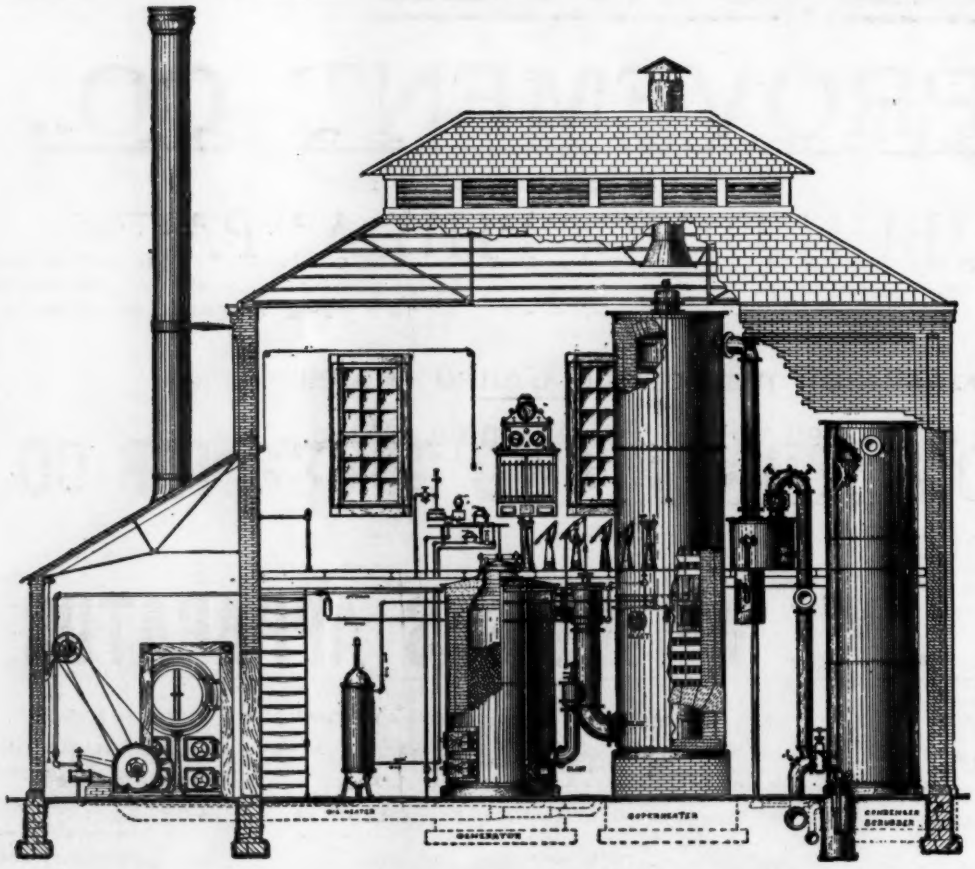

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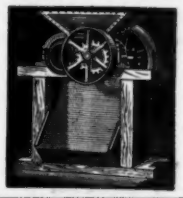

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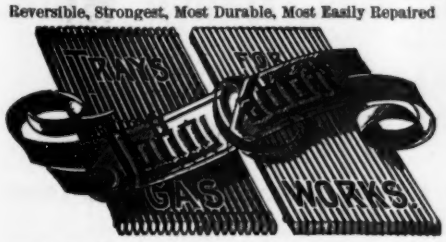

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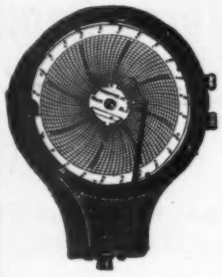

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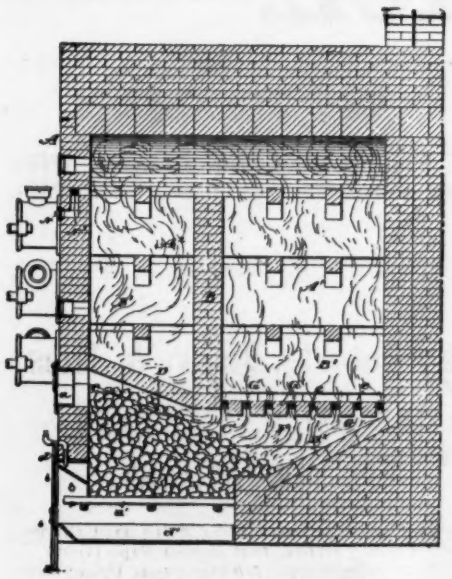

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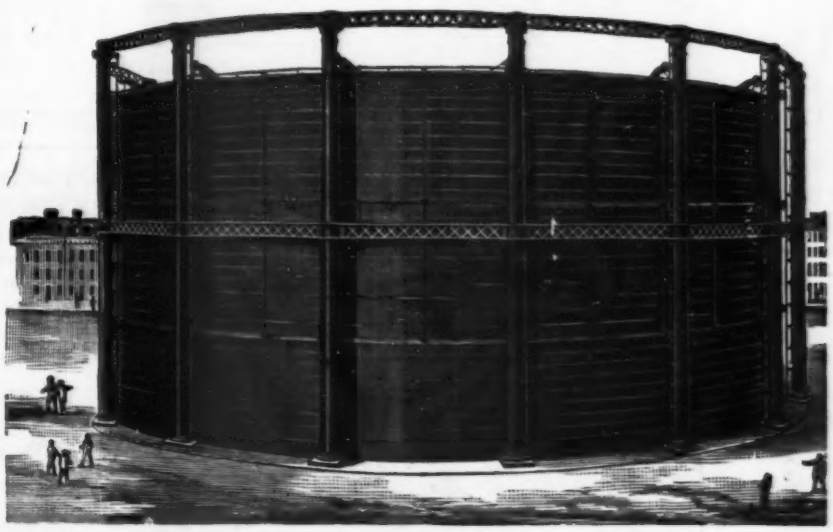

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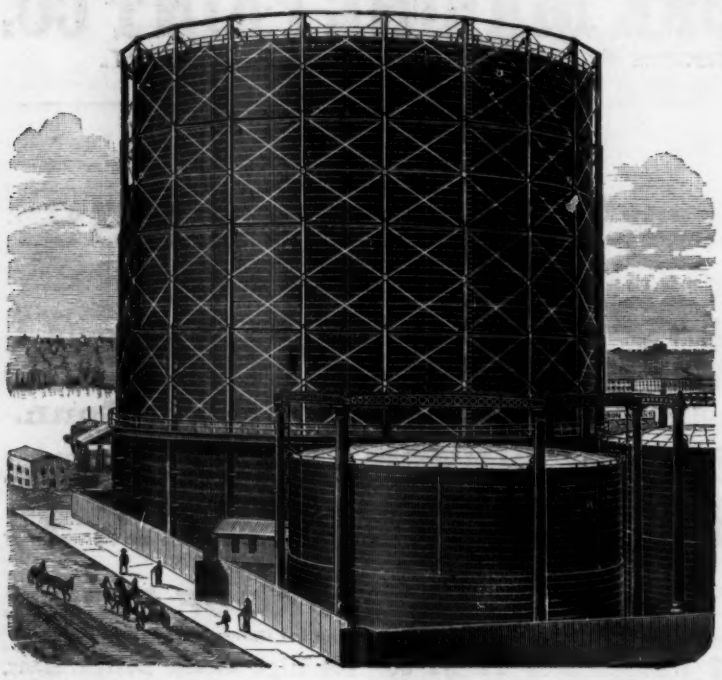

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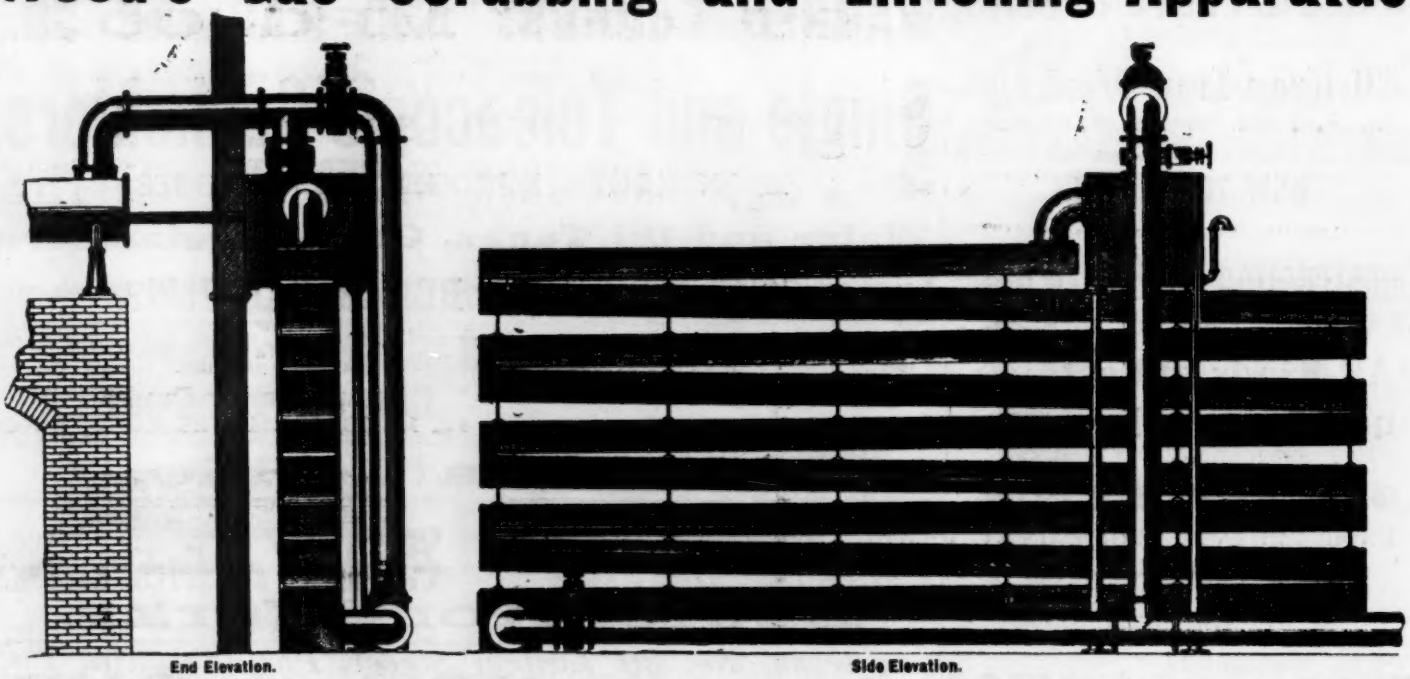

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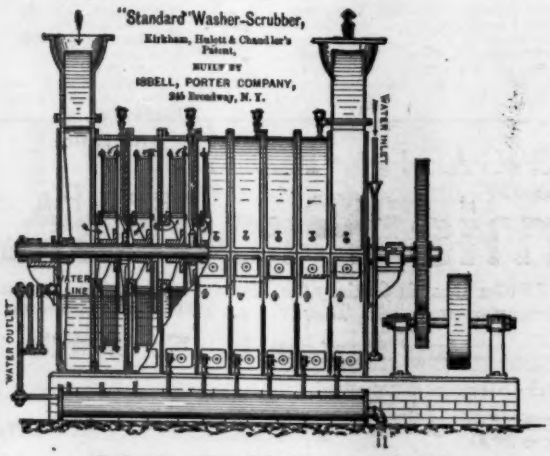

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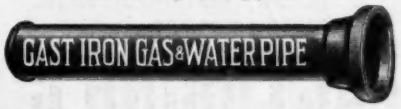

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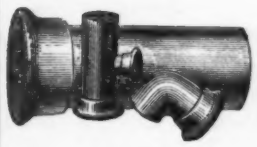

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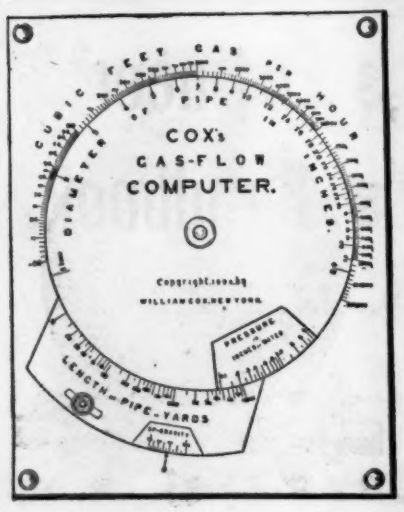

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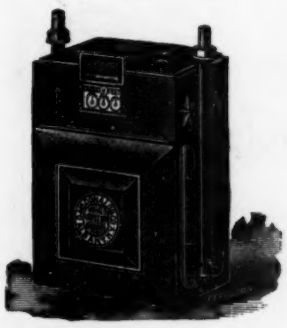

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